

SYLLABUS

ESTIMATING AND COSTING (CE-405-F)

Sessional	:	50 Marks
Theory	:	100 Marks
Total	:	150 Marks
Duration of Exam	:	3 Hours

SECTION A: Estimate

Principle of estimation, units, item work, different kinds of estimates, different methods of estimation, estimation of materials in single room building, two room building, multi storey buildings, with different sections of walls foundation, floors and roofs, R.B and R.C.C. works, Plastering, white washing, Distempering and painting, doors and windows, lump sum items, Estimates of canals, dams, barrage, Hilly roads, etc.

SECTION B: Specification of Works

Necessity of specification types of specification, general, specification, specification of bricks, cement, sand, water, lime, reinforcement: detailed specification for earthwork, cement, concrete, brickwork, flooring, D.P.C., R.C.C., cement plastering, white and colour washing, distempering, painting.

SECTION C: Rate analysis

Purpose, importance and requirements of rate analysis, units of measurement preparation of rate analysis, procedure of rate analysis for items: Each work, concrete works, R.C.C. works, reinforce brick work, plastering, painting, finishing (white washing, distempering).

SECTION D: Public Works Account

Tender and acceptance of tender, Earnst money, security money, retention money, measurement book, cash book, preparation, examination and payment of bills, first and final bills, administrative sanction, technical sanction. Billing—maintenance of muster ROLL, preparation of pay bill, measurement of work for payment of contractors, different types of

payment—first and final, running advance and final payment, Valuation Purpose of valuation, principles of valuation depreciation, sinking fund, salvage and scrap value, valuation of a building—cost method, rental—return method.

Note: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q. 1. This Q. 1 is compulsory and of short answer type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Books Recommended:

1. Dutta BN—Estimating and Costing
2. Chakraborty—Estimate Costing and Specification in Civil Engg.
3. Kohli & Kohli—A textbook on estimating and costing (Civil) with drawings Ambala Ramesh Publications.
4. Rangwala SC—Estimating and Costing—Anand Charotar Book Stall.

ESTIMATING AND COSTING

December-2013

Paper Code: CE-405-F

Q. 1. (a) Define earnest money and retention money.

Ans. Earnest and Retention Money: While submitting a tender, the contractor is to deposit a certain amount about 2% of the estimated cost, with the department, as earnest money/retention money as guarantee of the tender.

(b) Enumerate the different methods to calculate earthwork.

Ans. Different methods of calculate earthwork:

- Separate or individual wall method.
- Centre line method.

(c) What are the different types of specifications?

Ans. Different types of specifications:

- General, specifications or brief specification.
- Detailed specifications.

(d) Briefly describe the purpose and importance of analysis of rates?

Ans. For the purpose of analysis, the details about all the operations involved in carrying out the work should be available, the quantities of materials required and their costs should be known and the no. of different categories of labourers required and the capacity of doing work per labourer and their wages per day should be known.

(e) Mention general specifications for flooring of first class building.

Ans. Flooring: Drawing room and dining room floors shall be of Terrazo. Bathroom and W.C. floors and dado shall be of mosaic floors of bedrooms shall be coloured and polished of 2.5 cm (1") cement concrete over 7.5 cm (3") lime concrete floors of others shall be 2.5 cm (1") cement concrete over 5" (1.5 cm) lime concrete polished.

(f) Cash book and measurement book.

Ans. Cash book and measurement book:

- The transactions relating to the actual receipt and payment of cash are recorded in a register, made of P.W.A. form No. 1 c/a cash book.
- The measurements of all works and supplies are recorded in the measurement book form No. 23.

(g) Security deposit.

Ans. Security deposit: An acceptance of the tender, the contractor has to deposit 10% of the tendered amount as security money with the department.

(h) **Administrative approval.**

Ans. Administrative approval: For any work or project required by a department, an approval or sanction of the competent authority of the department, w.r.t. the cost and work is necessary at the first instance.

(i) **Valuation and its purpose.**

Ans. Valuation and its purpose: It is the technique of estimating or determining the fair price or value of a property such as a building, a factory, other engg. structures of various types, etc. By valuation, the present value of a property is determined.

(j) **Estimate.**

Ans. Estimate: It is the probable cost of a work and is usually prepared before the construction is taken up. It is used to enable one to know beforehand the cost of work.

SECTION-A

Q. 2. (a) What are the different types of Estimation? Explain Plinth Area Estimation and detailed Estimation.

Ans. Different Types of Estimate: The following are the different types of estimate:

- (1) Preliminary Estimate
- (2) Plinth Area Estimate
- (3) Cube Rate Estimate or Cubical Content Estimate
- (4) Approximate Quantity Method Estimate
- (5) Detailed Estimate or Item Rate Estimate
- (6) Revised Estimate
- (7) Supplementary Estimate
- (8) Supplementary and Revised Estimate
- (9) Annual Repair or Maintenance Estimate.

Plinth Area Estimate for Building (P.A. Estimate): This is prepared on the basis of plinth area of building, the rate being deducted from the cost of similar building having similar specification, height and construction, in the locality. Plinth area estimate is calculated by finding the plinth area of the building and multiplying by the plinth area rate. The plinth area should be calculated for the covered area by taking external dimension of the building at the floor level.

Detailed Estimate or Item Rate Estimate: Detailed estimate is an accurate estimate and consists of working out the quantities of each items of work and working the cost. The dimensions, length, breadth and height of each item are taken out correctly from drawing and quantities of each item are calculated, and abstracting and billing are done.

(b) Describe general items of work for building construction.

Ans. Items of Works: The main items of works are:

- Earthwork
- Soiling
- Concrete in foundation

- Damp proof course
 - Masonry
 - **Earthwork:** Earthwork is excavation and earthwork in filling are usually taken out separately under different items and quantities are calculated in cu.m.
 - **Concrete in foundation:** The concrete is taken out in cu.m by length \times breadth \times thickness. The length and breadth of foundation concrete are usually the same as for excavation, only the depth or thickness differs.
 - **Soiling:** When the soil is soft or bad, one layer of dry brick or stone soiling is applied below the foundation concrete. The soiling layer is computed in m^2 (length \times breadth) specifying the thickness.
 - **Damp proof course:** D.P.C. usually of 2.5 cm (1") thick rich cement concrete 1:1½:3 or 2 cm (¾") thick rich cement mortar 1:2, mixed with standard water proofing material is provided at the plinth level to full width of plinth wall and the quantities are computed in m^2 (length \times breadth).
 - **Masonry:** It is computed in m^3 (L \times B \times H). Foundation and plinth masonry is taken under one item, and masonry in superstructure is taken under a separate item.
- Q. 3. Calculate the Details of Measurement and Quantity of One room of given figure. I by using Long Wall and Short Wall Method?** 20

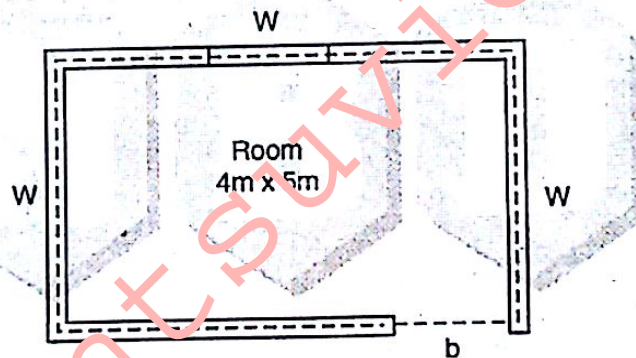
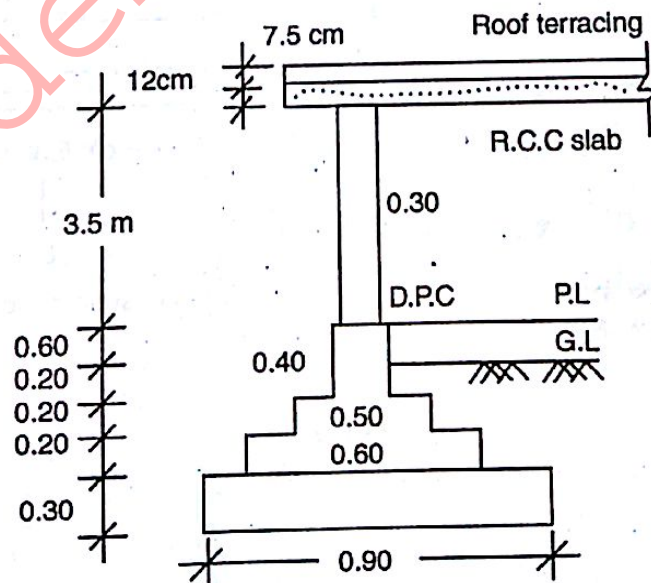


Figure 1



Ans. The length of long wall centre to centre = $5.00 + \frac{1}{2} \times .30 + \frac{1}{2} \times .30 = 5.30$ m.
 The length of short wall centre to centre = $4.00 + \frac{1}{2} \times .30 + \frac{1}{2} \times .30 = 4.30$ m.

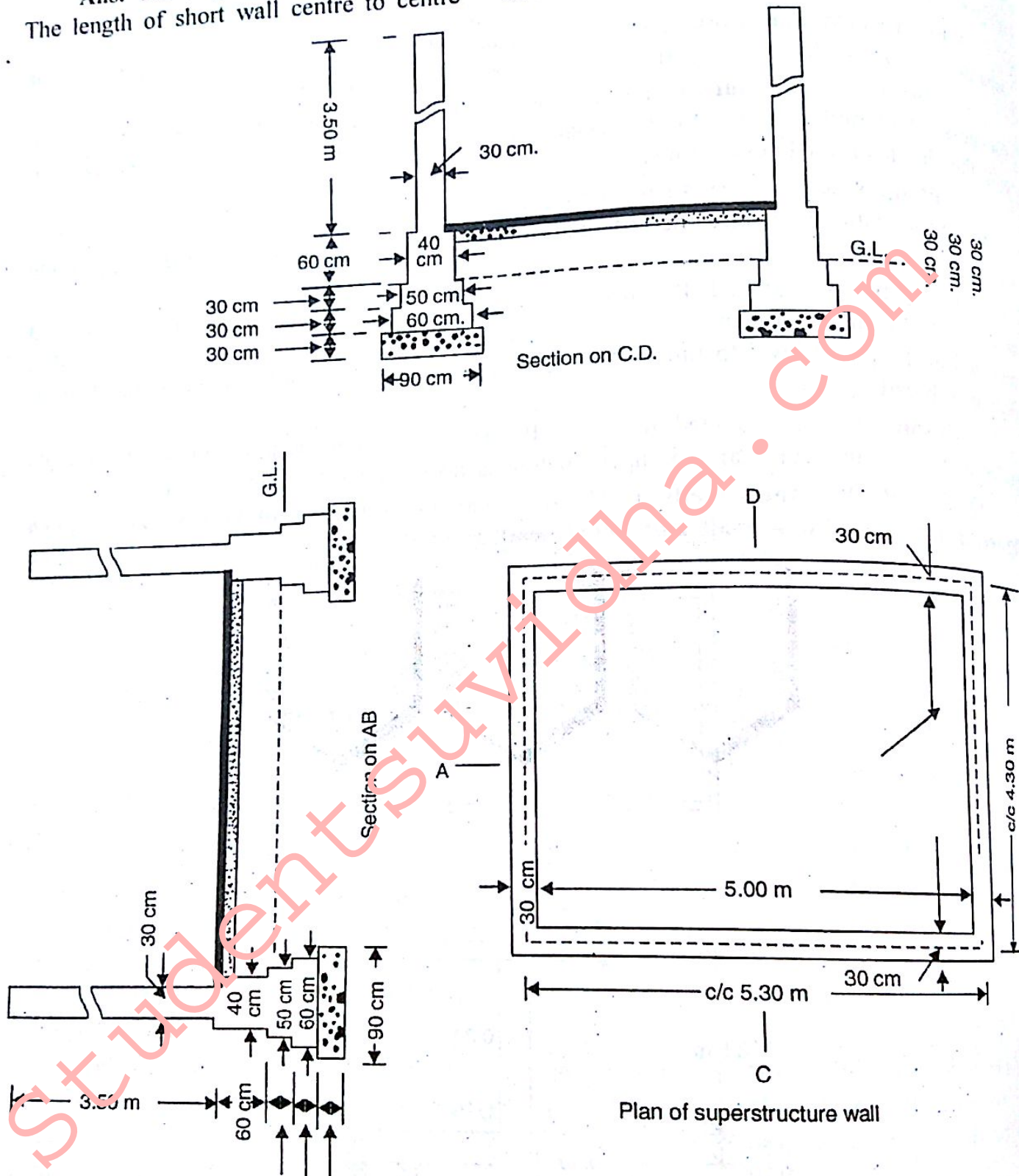


Fig. 2

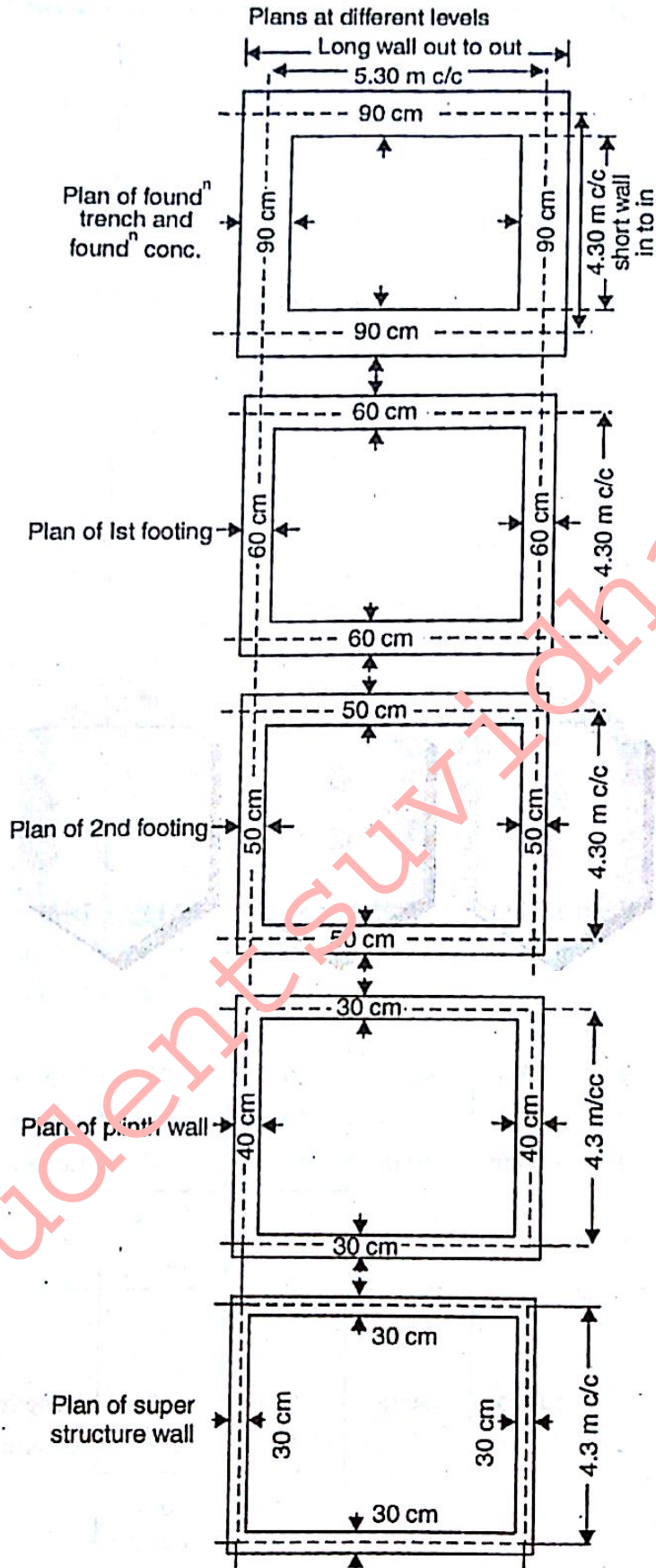


Fig. 3 Plans at different levels

Details of Measurement and Calculation of Quantities

S. No.	Particulars of Items	No.	Length	Breadth	Height or Depth	Quantity	Explanatory note
1.	Earthwork in excavation in foundation—						
	Long walls ...	2	6.20 m	.90 m	.90 m	10.04	Length = $5.30 + .90 = 6.20$ m Breadth = $4.30 - .90 = 3.40$ m
	Short walls ...	2	3.40 m	.90 m	.90 m	5.51	
					Total	15.55 cu m	
2.	Concrete in foundation—						
	Long walls ...	2	6.20 m	.90 m	.30 m	3.35	Length same as for excavation Quantity = 1/3 of excavation
	Short walls ...	2	3.40 m	.90 m	.30 m	1.83	
					Total	5.18 cu m	
3.	Brickwork in foundation and plinth—						
	Long walls—						
	1st footing ...	2	5.90 m	.60 m	.30 m	2.13	Length = $5.30 + .60 = 5.90$ m
	2nd footing ...	2	5.80 m	.50 m	.30 m	1.74	Length = $5.30 + .50 = 5.80$ m
	Plinth walls ...	2	5.70 m	.40 m	.60 m	2.74	Length = $5.30 + .40 = 5.70$ m
	Short walls—						
	1st footing ...	2	3.70 m	.60 m	.30 m	1.33	Length = $4.30 - .60 = 3.70$ m
	2nd footing ...	2	3.80 m	.50 m	.30 m	1.14	Length = $4.30 - .50 = 3.80$ m
	Plinth walls ...	2	3.90 m	.40 m	.60 m	1.87	Length = $4.30 - .40 = 3.90$ m
					Total	10.95 cu m	
4.	Brickwork in superstructure						
	Long walls ...	2	5.60 m	.30 m	3.50 m	11.76	Length = $5.30 + .30 = 5.60$ m
	Short walls ...	2	4.00 m	.30 m	3.50 m	8.40	Length = $4.30 - .30 = 4.00$ m
					Total	20.16 cu m	

Note: The door openings, window openings, lintels, etc. shall have to be deducted from superstructure as usual.

SECTION-B

Q. 4. (a) Explain the general specifications of First class Building.

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Ans. General Specification of First Class Building:

Foundation and plinth: Shall be of I-class brick work in lime mortar or 1:6 cement mortar over lime concrete or 1:4:8 cement concrete.

Damp proof course: D.P.C. shall be 2.5 cm (1") thick cement concrete 1:1½:3 mixed with one kg of compermo per bag of cement or other standard water proofing material as specified and painted with two coats of bitumen.

Superstructure: Shall be of I-class brickwork with lime mortar or 1:6 cement mortar. Lintels over doors and windows shall be of R.C.C.

Roofing: Roof shall be of R.C.C. slab with an insulation layer and lime concrete terracing above, supported over R.S. joists or R.C.C. beams as required. Heights of rooms shall not be less than 3.7 m (12 feet).

Flooring: Drawing room and dinning room floors shall be of mosaic (terrazo). Bathroom and W.C. floors and dado shall be of mosaic (terrazo).

Finishing: Inside and outside walls shall be of 12 mm (½") cement lime plastered 1:1:6. Drawing, dinning and bedrooms-inside shall be distempered and other inside white washed 3 coats.

Miscellaneous: Rain water pipes of cast iron or asbestos cement shall be provided and finished painted.

(b) Describe the detailed specifications of R.C.C. Slab (1:2:4), D.P.C (1:1:5:3) and painting.

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Ans. Reinforced Concrete Cement (R.C.C): Steel—steel reinforcing bars shall be of mild steel or deformation steel of standard specifications and shall be free from corrosion, loose rust scales, oil, grease, paint etc. The steel bars shall be round and capable of being bent (doubled over) without fracture. Materials for concrete-cement, sand and coarse aggregate shall be same as for cement concrete. The stone aggregate shall usually be 20 mm to 6 mm (¾" to 1/4") gauge unless otherwise specified.

Materials—Damp proof course shall consist of cement, coarse sand and stone aggregate of 1:1½:3 proportion with 2% of impermo or cem-seal, or Acco proof by weight of cement or other standard water proofing compound (1 kg per bag of cement). The damp proof course shall be applied at the plinth level in a horizontal layer of 2.5 cm thickness.

The brand of the paint shall be specified and ready-made paint of the required colour should be used. If thinning is required, pure turpentine may be added to the require extent. The surface shall be made perfectly smooth by rubbing with sand paper of different grades, first with coarse one and successively with fine sand papers.

Q. 5. (a) Differentiate between Ist class, IInd class and IIIrd class buildings.

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Ans. General Specification of First Class Building:

Foundation and plinth: Shall be of I-class brick work in lime mortar or 1:6 cement mortar over lime concrete or 1:4:8 cement concrete.

Damp proof course: D.P.C. shall be 2.5 cm (1") thick cement concrete 1:1½:3 mixed with one kg of impermo per bag of cement or other standard water proofing materials as specified and painted with two coats of bitumen.

Roofing: Roof shall be of R.C.C. slab with an insulation layer and lime concrete terracing above, supported over R.S. joists or R.C.C. beams as required. Heights of rooms shall not be less than 3.7 m (12 feet).

Superstructure: Shall be of I-class brickwork with lime mortar or 1:6 cement mortar. Lintels over doors and windows shall be of R.C.C.

Flooring: Drawing room and dinning room floors shall be of mosaic (terrazo). Bathroom and W.C. floors and dado shall be of mosaic (terrazo).

Finishing: Inside and outside walls shall be of 12 mm (½") cement lime plastered 1:1:6. Drawing, dinning and bedrooms-inside shall be distempered and other inside white washed 3 coats.

Miscellaneous: Rain water pipes of cast iron or of asbestos cement shall be provided and finished painted. Building shall be provided with 1st class sanitary and water fittings and electrical installations.

General Specifications of a Second Class Building:

Foundation and plinth: Foundation and plinth shall be of 1st class brickwork with lime mortar over lime concrete.

Damp proof course: D.P.C. shall be of 2 cm (¾") thick cement concrete 1:2 mixed with 1 kg of impermo per bag of cement or other standard water proofing materials.

Superstructure: Shall be of 2nd class brickwork in lime mortar. Lintels over doors and windows shall be of R.B.

Roofing: Roof shall be R.B. slab with 7.5 cm lime concrete terracing above (or flat terraced roof supported over wooden battens and beams, or jack arch roof). Varandah roof may be of A.C. sheet or Allahabad tiles.

Flooring: Floors shall be 2.5 cm (1") cement concrete over 7.5 cm (3") L.C. verandah floor shall be of brick tile or flag stone over lime concrete, finished cement painted.

Finishing: Inside and outside walls shall be of 12 mm lime mortar plastered 1:6. Ceiling shall be cement plastered 1:3. Inside shall be white washed 3 coats, colour washed two coats over one coat of white wash.

Miscellaneous: Rain water pipes shall be of cast iron finished painted. Electrification and sanitary and water fittings may be provided.

General Specifications of a Third Class Building:

Foundation and plinth: Foundation and plinth shall be of 2nd class brick work in lime mortar over lime concrete. Damp proof course shall be 2 cm thick cement mortar 1:2 mixed with standard water proofing compound.

Superstructure: Shall be of second class brickwork in mud mortar. Door and window opening shall be provided with arches of 2nd class brickwork in lime mortar or with wooden planks.

Roofing: Roof shall be of mud over tiles or bricks or planks over wooden beams or of tile or G.I. sheet or A.C. sheet sloping roof.

Flooring: Floor shall be of brick-on-edge floor over well rammed earth.

Finishing: Inside and outside walls shall be plastered with lime mortar and white washed three coats.

Doors and Windows: Chaukhat shall be of salwood, and shutters of chir mango or other country wood. Doors and windows shall be painted two coats with ordinary paint over one coat of priming.

(b) Describe the advantages and disadvantages of open and closed specification. 10

Ans. Advantage and Disadvantage of Open and Closed Specification: Specification specifies or describe the nature and the class of the work, materials to be used in the work, workmanship, etc. and is very important for the execution of the work. The cost of a work depends much on the specifications. Specifications should be clear and there should not be any ambiguity anywhere. From the study of the specifications one can easily understand the nature of the work and what the work shall be. The drawing of a building or structure show the arrangement of the rooms and various parts, and the dimensions—length, breadth and height with very brief descriptions of different parts.

Specification depend on the nature of the work, the purpose for which the work is required, strength of the materials, availability of materials, quality of materials, etc.

Specification are of two types:

- (1) General specification or brief specifications and
- (2) Detailed specification.

General or brief specification: General specifications gives the nature and class of the work and materials in general terms, to be used in the various parts of the work, from the foundation to the superstructure. It is a short description of different parts of the work specifying materials.

SECTION-C

Q. 6. Describe in detail the procedure of rate analysis for reinforced brick work, concrete work, earth work, plastering and painting. 20

Ans. Earthwork:

- Calculate materials required like labour etc.
- Labour i/c mistri, mazdoor, boy or woman coolie, sundries (T&P), etc.
- Add 10% contractor's profit.
- Then calculate the rate per cubic metre.

Concrete Works:

- Calculate materials required (i/c stone ballast, sand (coarse), cement, etc.)
- Calculate labour required (head mason, mason, beldar, boy or woman coolie, bhisti (i/c curing), forms, sundries (T&P) etc.).
- Add 1½% water charges.
- Add 10% contractor's profit.
- Then calculate the rate per cubic metre.

Finishing (White Washing, Distempering):

- Calculate the materials required (white lime slaked, glue powder, blue (pigment colour), colouring matter (pigment)).
- Calculate the labour required (white washer, boy coolie, sundries (T&P)).
- Then calculate the rate per sq. m.

Reinforced Brick Work:

- Calculate materials required (Brick I-class, cement, sand (coarse), mild steel rods).
- Calculate labour required (Head mason, mason, mazdoor/beldar, boy or woman coolie, bhisthi (i/c curing), sundries (T&P)).
- Calculate bending and cranking steel bars:
 - Blacksmith (IInd class), Mazdoor (Beldar) (T&P).
- Centering and shuttering (both erection and dismantling):
 - Timber planks and ballies
 - Carpenter (IInd class)
 - Mazdoor (Beldar)
 - Nails
 - T&P.
- Then add 1½% water charges and 10% contractor's profit.
- Then calculate rate per m³.

Q. 7. (a) Determine the rate for a wall of 20 m length, 5 m height and 30 cm nominal thickness. 10

Ans. Normally mortar joint will be less than 1 cm, taking 1 cm mortar joint, the actual thickness of wall be 29 cm.

$$\therefore \text{Actual volume} = 20 \times 0.29 \times 5 = 29 \text{ m}^3$$

No. of standard bricks of 20 cm × 10 cm × 10 cm × nominal size

$$= \frac{29}{0.20 \times 0.10 \times 0.10} = 14500 \text{ Nos.}$$

$$\therefore \text{No. of bricks per cu-m (nominal)} = \frac{14500}{30} = 484 \text{ No.s}$$

- Considering 5% breakages, wastages etc. \approx 500 Nos. per cu.m.
- For 10 cu.m of between 5000 bricks are required.

(b) Describe the unit of measurement and mode of measurement for the following items of work:

- Earth filling in plinth
- Damp proof course
- White washing
- Distempering

Ans. (i) Earth filling in plinth: Earthwork in excavation and earthwork in filling are usually taken out separately under different items and quantities are calculated in cu m. 10

(ii) **Damp proof course:** D.P.C. usually of 2.5 cm (1") thick rich cement concrete 1:1½:3 or 2 cm (¾") thick rich cement mortar 1:2 mixed with standard water proofing material, is provided at the plinth level to full width of plinth wall, the quantities are computed in sq. metre (length × breadth).

(iii) **White washing:** The quantities are computed in square metre and are usually same as for plastering. The inside is usually white washed or distempered and this item will be same as for inside plaster. The outside is colour-washed and the quantities of colour-washing will be same as for outside plaster. These items need not be calculated separately, but simply written as same as for inside plaster or outside plaster.

(iv) **Distempering:** The brand of the paint shall be specified and ready made paint of the required colour should be used. If thinning is required, pure turpentine may be added to the required extent. The surface shall be made perfectly smooth by rubbing with sand paper of different grades, first with coarse one and successively with fine sand papers.

SECTION-D

Q. 8. (a) What is Muster Roll? What are the rules for writing muster roll? Give common irregularities which may occur in the maintenance of muster roll. 15

Ans. Muster Roll: Work may be executed departmentally by employing daily labour, as masons, coolies, bhisties, carpenters, etc. The materials required for the construction as bricks, cement, sand, lime, surkhi, timber, steel, etc. and the tools and plants required for the operation, are got issued from the store by indent or purchased directly chargeable to the work. The attendance of the labourers is kept in muster roll by the overseer or by his authorised agent as work-supervisor, mistry, mate etc. The attendance of labour is checked, and initiated by Assistant Engineer or Sub-divisional or Divisional Engineer frequently during their inspections.

Muster Roll (M.R): The muster roll consists of two parts:

Part I: Nominal roll where daily attendance are recorded. In this part there are column and spaces for the names of the labourer, designation, father's name, dates of attendance, rates, total amount due for each, total amount due for whole, signature of the person taking attendance, signature of the officer making payment etc. and these column are duly filled up. Fines if inflicted on the labourer is recorded in Part I. Muster Roll should never be made in duplicate and entries should be made in such manner (with ink) that it may not be possible to interpolate or to alter them.

Part II: Details of quantity of work done by the labourer and the progress of work are recorded in this part. Details of measurement are taken and entered in the measurement book and an "Abstract of quantities" is prepared sub-headwise and this 'abstract of quantities' is recorded in part II of the Muster Roll giving reference of M.B. If the work is not susceptible to measurement, a remark to this effect should be recorded in this part.

(b) Explain the rental-return method of valuation in detail. 5

Ans. Method of Valuation: The following are the different methods of valuation:

(1) Rental method of valuation (2) Direct comparisons of the capital value (3) Valuation based on the profit (4) Valuation based on the cost (5) Development method of valuation (6) Depreciation method of valuation.

Rental method of valuation: In this method, the net income by way of rent is found out by deducting all outgoings from the gross rent. A suitable rate of interest as prevailing in the market is assumed and year's purchase is calculated. This net income multiplied by Y.P. gives the capitalized value or valuation of the property. This method is applicable only when the rent is known as probably rent is determined by enquiries.

Q. 9. (a) What is tender? What are the various features essential for a tender?

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Ans. Tender: It is an offer in writing to execute some specified work or to supply some specified articles at certain rates, within a fixed time under certain conditions of contract and agreement, between the contractor and the department or owner or party. The construction of work is usually done by contract. Scaled tenders are invited and the work is usually entrusted to the lowest tender. While inviting tenders the bill of quantities, detailed specifications, conditions of contract and plans and drawings are supplied on payment of the requisite cost to the contractors who tender or quote their rates.

(b) Describe the following terms:

10

Depreciation fund

Salvage and Scrap value

First and final bill

Different types of payments

Ans. Depreciation fund: It is the gradual exhaustion of the usefulness of a property. This may be defined as the decrease or loss in the value of property due to structural deterioration use, life wear and tear, decay and obsolescence. The value of a building or structure will be gradually reduced due to its use, life, wear and tear, etc. and a certain percentage of the total cost may be allowed as depreciation to determine its present value. Usually a percentage on depreciation per annum is allowed.

Scrap value: It is the value of dismantled materials. For a building when the life is over at the end of its utility period the dismantled materials as steel, bricks, timber, etc. will fetch is a certain amount which is the scrap value of the building.

Salvage value: It is the value at the end of the utility period without being dismantled. A machine after the completion of its usual span of life or when it become uneconomic, may be sold and one may purchase the same for some other purpose, the sale value of the machine is the salvage value.

First and final bill: The term indicates a single payment, made for a job or contract on its completion. In this case the payment finished by one payment after the completion of the work. This is usually applicable for small work.

Different types of payments: The payment to the contractors for works or for supply of materials, road, metal, tools and plants etc. are made on the basis of measurements recorded in the Measurement Book (M.B.) when the work or supply is completed or sufficiently progressed the detailed measurements are taken usually by the overseer and recorded in M.B. and an abstract of quantities is prepared and the cost is calculated.

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ESTIMATING AND COSTING

May-2013

Paper Code: CE-405-F

Q. 1. (a) What are supplementary units? 2

Ans. Supplementary units: In the international system of units, the quantities plane angle and solid angle are treated as independent quantities with S.I. units Radian (Rad.) and Steradian (Sr) respectively.

(b) Estimate the quantities of brickwork required in a wall 20 m long, 0.5 m high and 30 cm thick. 2

Ans. Normally mortar joint will be less than 1 cm; taking 1 cm mortar joint, the actual thickness of wall be 29 cm.

$$\therefore \text{Actual volume} = 20 \times 0.29 \times 5 = 29 \text{ m}^3$$
$$\text{No. of standard bricks of } 20 \text{ cm} \times 10 \text{ cm} \times 10 \text{ cm} \times \text{nominal size}$$
$$= \frac{29}{0.20 \times 0.10 \times 0.10} = 14500 \text{ Nos.}$$

$$\therefore \text{No. of bricks per cu-m (nominal)} = \frac{14500}{30} = 483 \text{ Nos.}$$

– Considering 5% breakages, wastages etc. = 500 Nos. per cu.m.

– For 10 cu.m of between 5000 bricks are required.

(c) List the various methods of calculating quantity of earthwork. 2

Ans. Various methods of calculate earthwork:

- Separate or individual wall method.
- Centre line method.

(d) What is the purpose of analysis of rates? 2

Ans. For the purpose of analysis, the details about all the operations involved in carrying out the work should be available, the quantities of materials required and their costs should be known and the no. of different categories of labourers required and the capacity of doing work per labourer and their wages per day should be known.

(e) What is the difference between brief specifications and detailed specifications. 2

Ans. Different types of specifications:

- General specifications or brief specification.
- Detailed specifications.

(f) Write the formula to find sinking fund? 2

$$\text{Ans. Sinking fund} = 1 = \frac{S_i}{(1+i)^n - 1}$$

where S = Total amount of sinking fund to be accumulated.

n = No. of years required to accumulate the S. Fund.

(g) Under what circumstances revised estimate is prepared? 2

Ans. The revised estimate is prepared when the original sanctioned estimate is exceeded or likely to exceed by more than 5%.

(h) What do you mean by overhead costs? 2

Ans. Overhead costs: These include general office expenses, rents, taxes, supervision and other costs which are indirect expenses and not productive expenses on the job.

(i) What is earnest money? 2

Ans. Earnest and Retention Money: While submitting a tender, the contractor is to deposit a certain amount about 2% of the estimated cost, with the department, as earnest money/retention money as guarantee of the tender.

(j) List the various methods of valuation. 2

Ans. Method of Valuation: The following are the different methods of valuation:

(1) Rental method of valuation (2) Direct comparisons of the capital value (3) Valuation based on the profit (4) Valuation based on the cost (5) Development method of valuation (6) Depreciation method of valuation.

Rental method of valuation: In this method, the net income by way of rent is found out by deducting all outgoings from the gross rent. A suitable rate of interest as prevailing in the market is assumed and year's purchase is calculated. This net income multiplied by Y.P. gives the capitalized value or valuation of the property. This method is applicable only when the rent is known as probably rent is determined by enquiries.

SECTION-A

Q. 2. (a) What is an estimate? Discuss its objects. What are the different approximate methods of preparing estimate? 10

Ans. Various methods of estimation: For symmetrical foundation, which is the usual case, earthwork in excavation in foundation, foundation concrete, brickwork in foundation and plinth and brickwork in superstructure may be estimated by the following 2 methods:

- Separate or individual wall method.
- Centre line method.

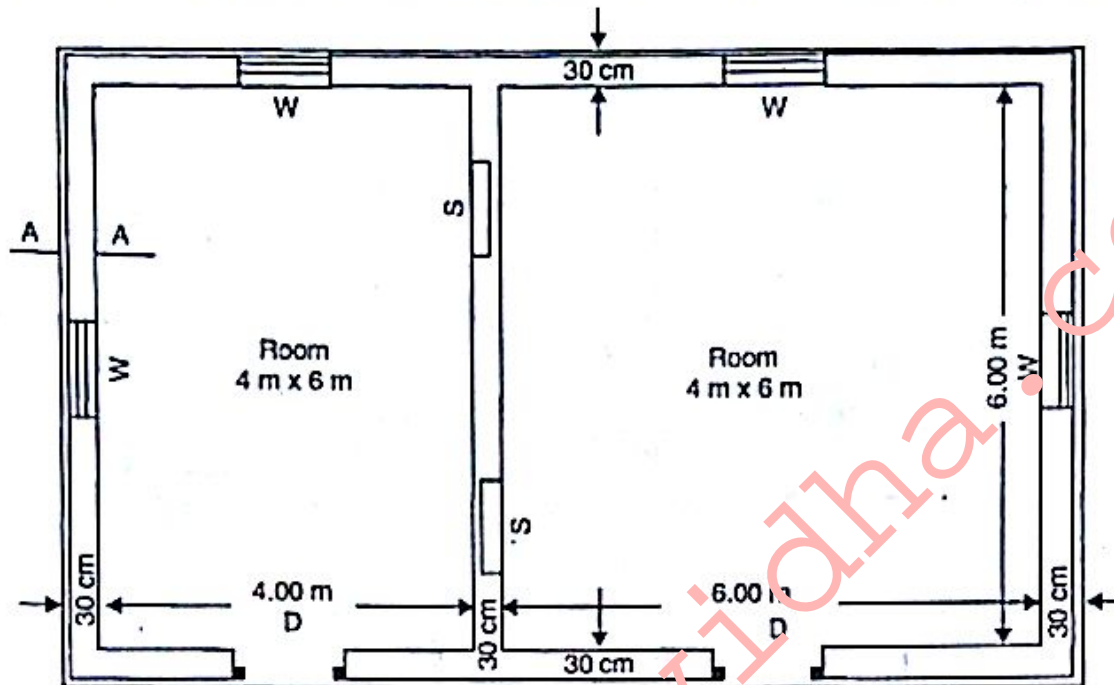
• In separate wall method, measure or find out the external length of walls running in the longitudinal direction generally the long walls out-to-out and the internal lengths of walls running in the transverse direction in-to-in i.e., of cross or short walls in-to-in and calculate quantities multiplying the length by breadth and height of the wall. The same rule applies to the excavation in the foundation, to concrete in foundation and to masonry.

• In centre line method, sum-total length of centre lines of walls, long and short, has to be found out find the total length of centre lines of walls, of same type, long and short having same type of foundations and footings and then find quantities by multiplying the total centre length, the respective breadth and the height. In this method, the length will remain the same for excavation in foundation, for concrete in foundation, for all footings and for superstructure. This method is quick but requires special attention and consideration at the junctions, meeting points of partition or cross walls etc.

(b) Estimate the quantities of following items of a 2-Room building from the given plan and section (Fig. 1):

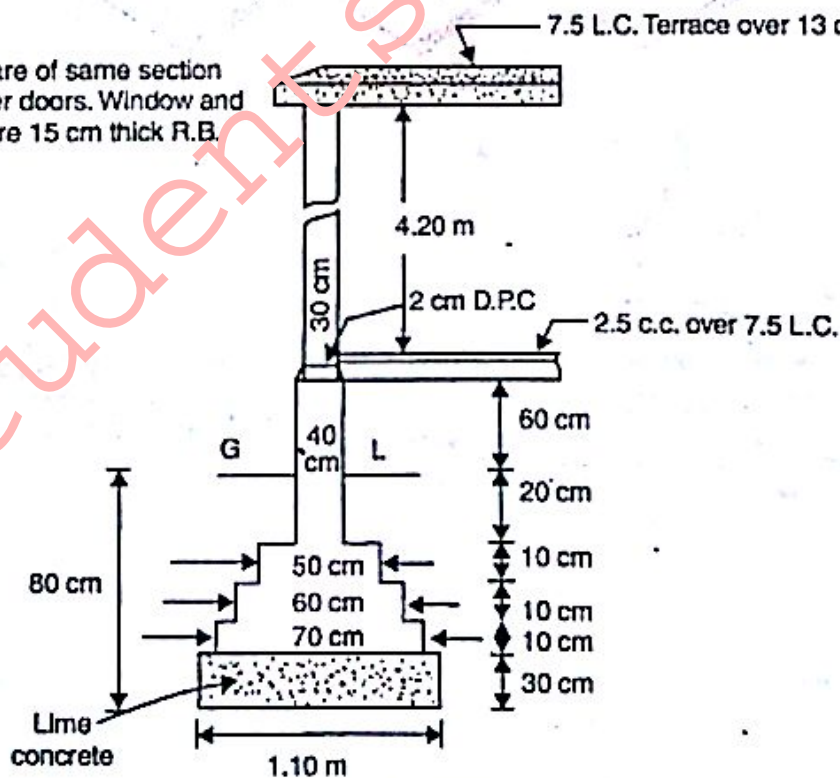
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- (i) E/W in estimation in foundation.
- (ii) Lime concrete in foundation.
- (iii) First class between in cement mortar 1:6 in foundation and plinth.



Doors D – 1.20 m x 2.10 m, Windows W – 1.00 m x 1.50 m, Shelves S – 1.00 m x 1.50 m

All walls are of same section
lintels over doors. Window and
shelves are 15 cm thick R.B.



Cross section of wall on AA.
Fig. 1

Ans.

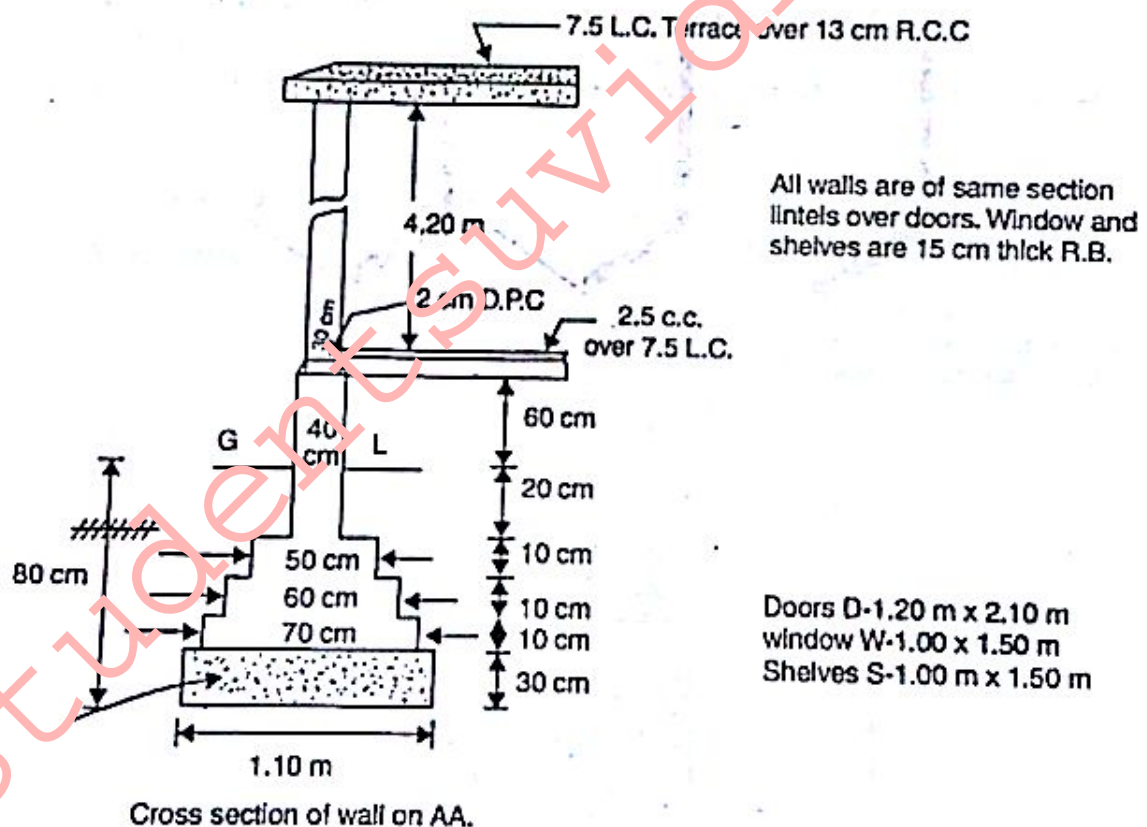
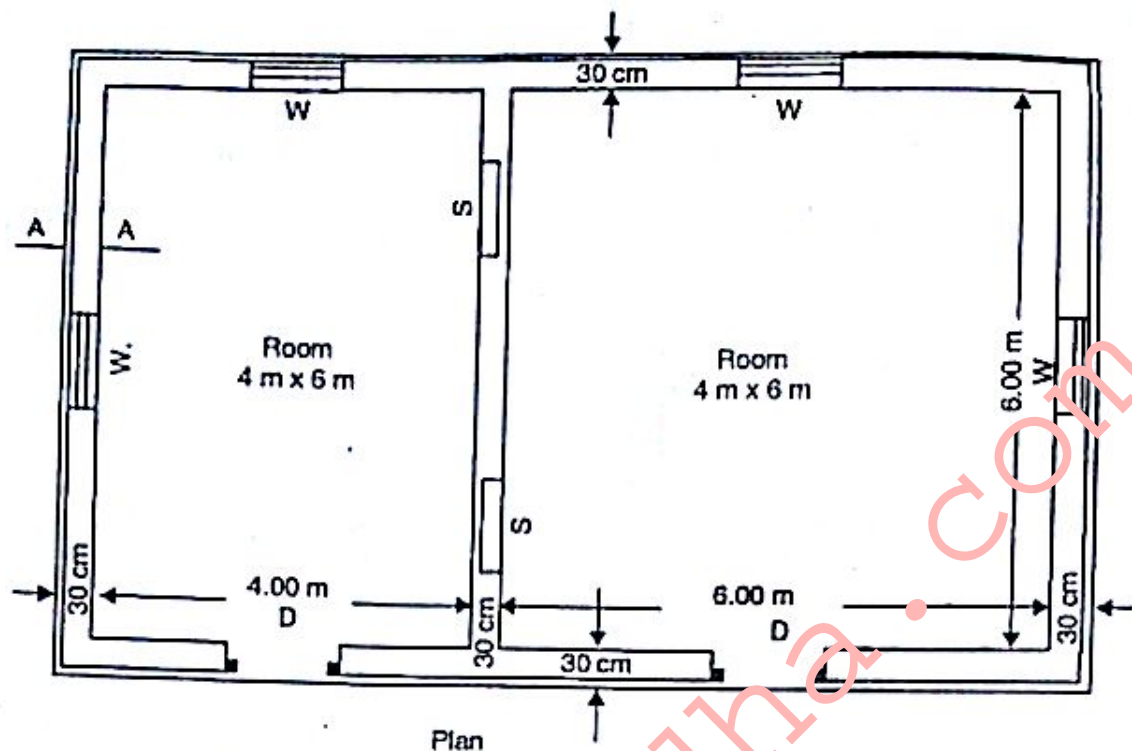


Fig. 2

Note: No beam has been shown in the plan as the object of this example is to explain the method of estimating the walls only.

Details of Measurement and Calculation of Quantities

Item No.	Particulars of Items	No.	Length	Breadth	Height or Depth	Quantity	Explanatory note
1.	Earthwork in excavation in foundation—						Long wall, c/c. length = $4 + 6 + .30 + 2 \times \frac{.30}{2} = 10.60$ m Short and Inter walls, c/c. length = $6 + 2 \times \frac{.30}{2} = 6.30$ m
	Long walls ...	2	11.70 m	1.10 m	1.00 m	25.74	$L = 10.60 + 1.10 = 11.70$ m
	Short walls ...	2	5.20 m	1.10 m	1.00 m	17.16	$B = 6.30 - 1.10 = 5.20$ m
					Total	42.90 cu m	
2.	Lime concrete in foundation—						
	Long walls ...	2	11.70 m	1.10 m	.30 m	7.72	Length same as for excavation
	Short walls ...	2	5.20 m	1.10 m	.30 m	5.15	Quantity = 3/10 of excavation
					Total	12.87 cu m	
3.	1st class brick-work in 1:6 cement mortar in foundation and plinth—						
	Long walls—						
	1st footing ...	2	11.40 m	.80 m	.20 m	3.65	$L = 10.60 + .80 = 11.40$ m
	2nd footing ...	2	11.30 m	.70 m	.10 m	1.58	$L = 10.60 + .70 = 11.30$ m
	3rd footing ...	2	11.20 m	.60 m	.10 m	1.34	$L = 10.60 + .60 = 11.20$ m
	4th footing ...	2	11.10 m	.50 m	.10 m	1.11	$L = 10.60 + .50 = 11.10$ m
	Plinth walls ... above footing	2	11.00 m	.40 m	.80 m	7.04	$L = 10.60 + .40 = 11.00$ m
	Short walls—						
	1st footing ...	3	5.50 m	.80 m	.20 m	2.64	$L = 6.30 - .80 = 5.50$ m
	2nd footing ...	3	5.60 m	.70 m	.10 m	1.16	$L = 6.30 - .70 = 5.60$ m

Note: Length of subsequent footings of long walls after 1st footing may be obtained simply by deducting 10 cm from first footing.

Item No.	Particulars of Items	No.	Length	Breadth	Height or Depth	Quantity	Explanatory note
4.	3rd footing ...	3	5.70 m	.60 m	.10 m	1.03	$L = 6.30 - .60 = 5.70 \text{ m}$
	4th footing ...	3	5.80 m	.50 m	.10 m	0.87	$L = 6.30 - .50 = 5.80 \text{ m}$
	Plinth walls ... above footing.	3	5.90 m	.40 m	.80 m	5.66	$L = 6.30 - .40 = 5.90 \text{ m}$
					Total	26.10 cu m	
	Damp proof course 2.5 cm thick c.c.—						
	Long walls ...	2	11.00 m	.40 m	—	8.80	Lengths same as for plinth wall in item 3.
	Short walls ...	3	5.90 m	.40 m	—	7.08	
					Total	15.88	
	Deduct door sills ...	2	1.20 m	.40 m	—	0.96	
				Net	Total	14.92 sq. m	
	1st class brick-work in lime mortar in superstructure						
	Long walls ...	2	10.90 m	.30 m	4.20 m	27.47	$L = 10.60 + .30 = 10.90 \text{ m}$
	Short walls ...	3	6.00 m	.30 m	4.20 m	22.68	$L = 6.30 - .30 = 6.00 \text{ m}$
					Total	50.15 cu m	
	Deduct—						
5.	Door openings	2	1.20 m	.30 m	2.10 m	1.51	
	Window openings ...	4	1.00 m	.30 m	1.50 m	1.80	
	Shelves ...	2	1.00 m	.20 m	1.50 m	0.60	Back of shelves 10 cm thick wall.
	Lintels over doors ...	2	1.50 m	.30 m	.15 m	0.14	Bearing 15 cm
	Lintels over windows ...	4	1.30 m	.30 m	.15 m	0.23	Bearing 15 cm
	Lintels over shelves ...	2	1.30 m	.30 m	.15 m	0.12	Bearing 15 cm
			Total of	deduct-	tion	4.40	cu m
			Net	Total		45.75	cu m

Note: Length of subsequent footing of short walls after 1st footing may be obtained simply by adding 10 cm from first footing.

Q. 3. (a) With the help of neat sketch, explain canal section:

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- (i) fully in excavation.
- (ii) partially in excavation and partially in embankment.
- (iii) fully in embankment.

Ans. (i)

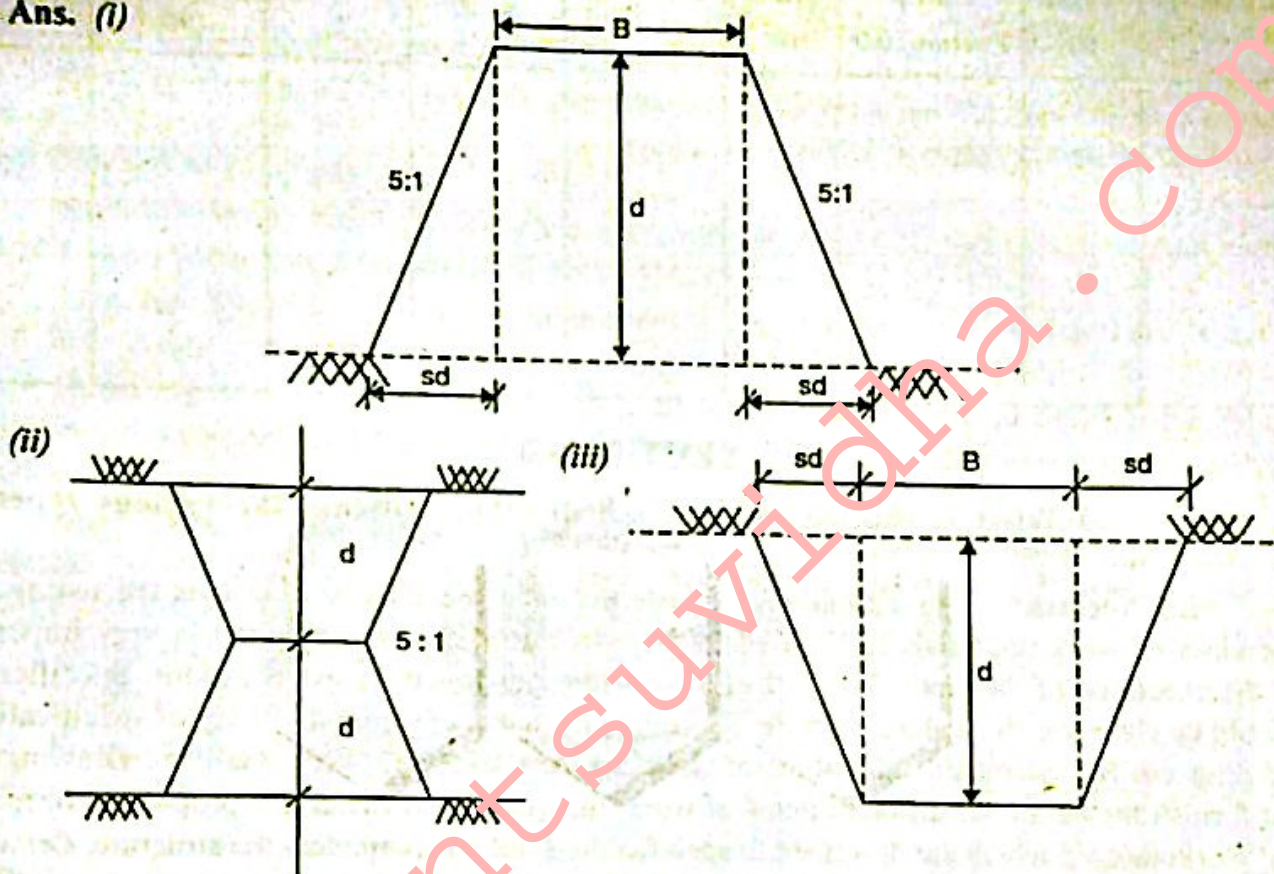


Fig. 3

(b) Discuss in detail the method used for calculation of quantities of E/W in a hill road. Make neat sketch if required.

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Ans. The quantity of earthwork may be calculated by the various methods of measurement out of which three methods are given below:

Method I: Mid Sectional Area Method

Method II: Mean Sectional Area Method

Method III: Prismoidal Formula Method

Method II: Mean Sectional Area Method: Quantity = Mean section area \times length,

Sectional area at one end $A_1 = Bd_1 + Sd_1^2$,

Sectional area at the other end $A_2 = Bd_2 + Sd_2^2$, d_1 and d_2 are the heights or depth at the two ends.

The mean sectional area,

$$A = \frac{A_1 + A_2}{2}$$

$$\text{Quantity, } Q = \frac{A_1 + A_2}{2} \times \text{Length}$$

The quantity of earthwork may be calculated in a tabular form is given below:

Stations or Chainage	Height or Depth (D)	Area of Untral Portion BD	Area of Sides Sd^2	Total Area $BD + Sd^2$	Mean Sectional Area	Length between Station L	$Q = (BD + Sd^2) \times L$	
							Embankment	Cutting

SECTION-B

Q. 4. (a) What is the necessity of specification? Discuss the various types of specifications.

Ans. Necessity of specifications: – Specifications specifies or describes the nature and the class of work, materials to be used in the work, workmanship etc. and is very important for the execution of the work. The cost of a work depends much on specifications. Specification should be clear and there should not be any ambiguity anywhere from the study of specifications one can easily understand the nature of the work and what the work shall be. Drawings do not furnish the details of different items of work, the quantity of materials, proportion of mortar and workmanship which are described in specifications define completely the structure. Drawing and specifications form important parts of contract document.

– Specifications depends upon the nature of the work, the purpose for which the work is required, strength of the materials, availability of materials, quality of materials etc.

– Specification area of 2 types:

(1) General or brief specification

(2) Detailed specification

– General specifications gives the nature and class of the work and materials in general terms to be used in the various parts of the work, from the foundation to the superstructure. It is a short description of different parts of works specifying materials, proportions, qualities etc.

– The detailed specification is a detailed description and express the requirements in details. The D.S. of an item of work specifies the qualities and quantities of materials, the proportion of mortar, workmanship, the method of preparation and execution and the method of measurement.

(b) Mention general specification of:

(i) first class building

Ans. General Specification of First Class Building:

Foundation and plinth: Shall be of 1-class brick work in lime mortar or 1:6 cement mortar over lime concrete or 1:4:8 cement concrete.

Damp proof course: D.P.C. shall be 2.5 cm (1") thick cement concrete 1:1½:3 mixed with one kg of impermo per bag of cement or other standard water proofing materials as specified and painted with two coats of bitumen.

Roofing: Roof shall be of R.C.C. slab with an insulation layer and lime concrete terracing above, supported over R.S. joists or R.C.C. beams as required. Heights of rooms shall not be less than 3.7 m (12 feet).

Superstructure: Shall be of 1-class brickwork with lime mortar or 1:6 cement mortar. Lintels over doors and windows shall be of R.C.C.

Flooring: Drawing room and dinning room floors shall be of mosaic (terrazo). Bathroom and W.C. floors and dado shall be of mosaic (terrazo).

Finishing: Inside and outside walls shall be of 12 mm (½") cement lime plastered 1:1:6. Drawing, dinning and bedrooms-inside shall be distempered and other inside white washed 3 coats.

Miscellaneous: Rain water pipes of cast iron or of asbestos cement shall be provided and finished painted. Building shall be provided with 1st class sanitary and water fittings and electrical installations.

(ii) second class building.

General Specifications of a Second Class Building:

Foundation and plinth: Foundation and plinth shall be of 1st class brickwork with lime mortar over lime concrete.

Damp proof course: D.P.C. shall be of 2 cm (¾") thick cement concrete 1:2 mixed with 1 kg of impermo per bag of cement or other standard water proofing materials.

Superstructure: Shall be of 2nd class brickwork in lime mortar. Lintels over doors and windows shall be of R.P.

Roofing: Roof shall be R.B. slab with 7.5 cm lime concrete terracing above (or flat terraced roof supported over wooden battens and beams, or jack arch roof). Varandah roof may be of A.C. sheet or Allahabad tiles.

Flooring: Floors shall be 2.5 cm (1") cement concrete over 7.5 cm (3") L.C. verandah floor shall be of brick tile or flag stone over lime concrete, finished cement painted.

Finishing: Inside and outside walls shall be of 12 mm lime mortar plastered 1:6. Ceiling shall be cement plastered 1:3. Inside shall be white washed 3 coats, colour washed two coats over one coat of white wash.

Miscellaneous: Rain water pipes shall be of cast iron finished painted. Electrification and sanitary and water fittings may be provided.

Q. 5. Write down the detailed specification of the following items of works: 20

(a) Damp proofing coarse

Ans. Damp proofing coarse: Materials—Damp proof coarse shall consist of cement, coarse sand and stone aggregate of 1:1½:3 proportion with 2% of impermo or cem-seal, or Acco proof by weight of cement or other standard water proofing compound (1 kg per bag of cement). The damp proof course shall be applied at the plinth level in a horizontal layer of 2.5 cm thickness.

(b) R.C.C.

Ans. R.C.C: Steel-steel reinforcing bars shall be of mild steel or deformation steel of standard specifications and shall be free from corrosion, loose rust scales, oil, grease, paint etc. The steel bars shall be round and capable of being bent (doubled over) without fracture. Materials for concrete-cement, sand and coarse aggregate shall be same as for cement concrete in item 4, the stone aggregate shall usually be 20 mm to 6 mm (¾" to ¼") gauge unless otherwise specified.

(c) Distempering

Ans. Distempering: The brand of the paint shall be specified and ready-made paint of the required colour should be used. If thinning is required, pure turpentine may be added to the require extent. The surface shall be made perfectly smooth by rubbing with sand paper of different grades, first with coarse one and successively with fine sand papers.

(d) Cement concrete 1:4:8 in foundation.

Ans. Cement concrete 1:4:8 in foundation: Materials—aggregate shall be of invert materials and should be clean, dense, hard, sound, durable, non-absorbent and capable of developing good bond with mortar. The proportion of concrete shall be 1:2:4 as Cement : Sand : Stone : Ballast by volume unless otherwise specified. Minimum compressive strength of concrete of 1:2:4 proportion shall be 140 kg per sq. km.

Mixing shall be done in masonry platform or sheet iron tray. For concrete of 1:2:4 proportion, first two boxes of sand and the bag of cement shall be mixed dry thoroughly and this dry mix of cement

SECTION-C

Q. 6. (a) What are the general steps for preparing of analysis of rates? 10

Ans. General Steps: • From the information regarding out turn, material, requirements rates, etc.

- Analysis of rates of different item of works may be worked out.
- The number of Mazdoors, Coolies, Bhishties, etc. may be adopted from general ideas and different operations of construction of the particular item of work.
- For lime concrete in foundation mason's work is very little but requirement of Mazdoor is taken as per mason is greater for mixing, carrying, laying, ramming, etc.
- Dry volume of material of mortar concrete is taken in calculation of analysis of rates.
- Sum of total volume cost of each ingredient and labour cost are added together.

(b) Write down unit of measurement, unit rate of payment and mode of measurement for the following general items of work: 10

- (i) Ballies (ii) R.C.C.
(iii) D.P.C. (iv) Plastering—cement mortar
(v) Skirting.

Ans. (i) Ballies: Wooden beams, burgahs, posts, wooden roof tusses, chowkhats, etc. come under this item, and the quantities are computed in cu m. The dimensions of finished work shall be taken.

(ii) R.C.C: R.C.C and R.B work may be in roof or floor slab, in beams, lintels, columns, foundation, etc. and the quantities are calculated in cu m. Length, breadth and thickness are found correctly from the plan, elevation and section or from other detailed drawings. Bearings are added with the clear span to get the dimensions. The quantities are calculated in cu m exclusive of steel reinforcement and its bending but inclusive of centering and shuttering and fixing and binding reinforcement in position.

(iii) D.P.C: D.P.C. usually of 2.5 cm (1") thick rich cement concrete 1:1½:3 or 2 cm (¾") thick rich cement mortar 1:2 mixed with standard water proofing material, is provided at the plinth level to full width of plinth wall, the quantities are computed in sq. metre (length × breadth).

(iv) Plastering—cement mortar: Usually 12 mm (½") thick is calculated in sq. m for walls the measurements are taken for the whole face of the wall for both sides as solid and deductions for openings are made in the manner:—

(a) No deduction is made for ends of beams, posts, rafters, etc.

(b) For opening above 3 sq. m (30 sq. ft) deduction is made for both faces of the opening and the jambs, soffits and sills are taken into account and added.

(v) Skirting: In walls is calculated in square metre for whole surface and deductions similar to plastering are made.

Q. 7. Analyse the rate of the following items of work. Assume suitable rate of material and labour. 20

(i) R.C.C. work in column 1:1½:3.

Ans. R.C.C. work in column 1:1½: 3: Unit 1 cu m. Take 10 cu m

Particulars	Quantity	Rate		Cost	
		₹	P.	₹	P.
Materials:					
Stone aggregate 20 mm	8.40 cu m	500.00	per cu m	4200.00	
Sand coarse	4.20 cu m	500.00	per cu m	2100.00	
Cement (64 bags)	2.80 cu m	3970.00	per cu m	11116.00	
Steel—Mild steel					
Bar @ 2% = 0.2 cu m	15.7 g	1450.00	per g	22765.00	
Binding wire	2.0 kg	20.00	per kg	40.00	
Total				40221.00	

Labour—Same as for item (7)

Banding and binding of steel bars

Blacksmith	12 nos.	80.00 per day	960.00
Beldar (Mazdoor)	12 nos.	50.00 per day	600.00
T. and P.	Lumpsum	15.00 L.S.	15.00
Total			1575.00

Lentering and Shuttering

Same as for item (7)

Total of materials and labour 45676.00

Add 1½% water charges 685.14

Add 10% contractor's profit 4567.60

Grand Total 50928.74

Rate per cu m = $50928.74/10 = ₹ 5092.90$ for 10 cu m

(ii) Painting with stiff paint one coat.

Ans. Painting with stiff paint one coat: Unit 1 sq. m. Take 100 sq. m.

Particulars	Quantity	Rate	Cost
		₹ P.	₹ P.
Materials:			
Paint (Stiff)	10 kg	30.00 per kg	300.00
Linseed oil (Boiled)	4.5 litre	50.00 per litre	225.00
Turpentine	3.0 litre	12.00 per litre	36.00
Total			561.00
Labour, etc.			
Painter	5 nos.	90.00 per day	450.00
Coolie	5 nos.	40.00 per day	200.00
Sundries, putty, brushes sand, etc.	Lumpsum	20.00 L.S.	20.00
Total			670.00

Total of materials and labour = 1231.00

Add 10% Contractor's profit = 123.10

Grand total = 1354.10

Rate per sq. m. = $1354.10/100$ for sq. m. = ₹ 13.50

(III) 2.5 m cement concrete floor 1:2:4.

Ans. Cement concrete 1:2:4: Unit 1 cu m. Take 2.5 cu m.

Particulars	Quantity	Rate	Cost
		₹ P.	₹ P.
Materials:			
Stone ballast 40 mm gauge	8.80 cu m	400.00 per cu m	3520.00
Sand (Coarse)	4.40 cu m	500.00 per cu m	2200.00
Cement (66 bags)	2.20 cu m	3970.00 per cu m	8734.00
		Total	14454.00
Labour:			
Mistri (Head mason)	½ no.	100 per day	33.30
Mason	2 nos.	90 per day	180.00
Mazdoor (Beldar)	12 nos.	50 per day	600.00
Boy or Woman Coolie	20 nos.	40 per day	800.00
Bhisthi (including curring)	6 nos.	50 per day	300.00
Forms' etc. (according to requirement)	Lump Sum	400 L.S.	400.00
Sundries, T. and P, etc.	Lump Sum	50 L.S.	50.00
		Total	2563.30
Total of materials and labour = 17017.30			
Add 1½% water charges = 255.25			
Add 10% Contractor's profit = 1701.73			
Grand total = 18974.28			
Rate per cu. m. = ₹ 18974.28/2.5 = ₹ 7589.712 for 2.5 cu m.			

SECTION-D

Q. 8. (a) What are the different types of payments made to the contractor? Explain.

10

Ans. Depreciation fund: It is the gradual exhaustion of the usefulness of a property. This may be defined as the decrease or loss in the value of property due to structural deterioration, use, life wear and tear, decay and obsolescence. The value of a building or structure will be gradually reduced due to its use, life, wear and tear, etc. and a certain percentage of the total cost may be allowed as depreciation to determine its present value. Usually a percentage on depreciation per annum is allowed.

Scrap value: It is the value of dismantled materials. For a building when the life is over at the end of its utility period the dismantled materials as steel, bricks, timber, etc. will fetch a certain amount which is the scrap value of the building.

Salvage value: It is the value at the end of the utility period without being dismantled. A machine after the completion of its usual span of life or when it become uneconomic, may

be sold and one may purchase the same for some other purpose, the sale value of the machine is the salvage value.

First and final bill: The term indicates a single payment, made for a job or contract on its completion. In this case the payment finished by one payment after the completion of the work. This is usually applicable for small work.

Different types of payments: The payment to the contractors for works or for supply of materials, road, metal, tools and plants etc. are made on the basis of measurements recorded in the Measurement Book (M.B.) when the work or supply is completed or sufficiently progressed the detailed measurements are taken usually by the overseer and recorded in M.B. and an abstract of quantities is prepared and the cost is calculated.

(b) What is valuation? Discuss the purpose of valuation. Explain rental return method of valuation in detail.

Ans. Tender: It is an offer in writing to execute some specified work or to supply some specified articles at certain rates, within a fixed time under certain conditions of contract and agreement, between the contractor and the department or owner or party. The construction of work is usually done by contract. Scaled tenders are invited and the work is usually entrusted to the lowest tender. While inviting tenders the bill of quantities, detailed specifications, conditions of contract and plans and drawings are supplied on payment of the requisite cost to the contractors who tender or quote their rates.

Q. 9. Write short notes on:

(a) Muster Roll

Ans. Muster Roll: Work may be executed departmentally by employing daily labour, as masons, coolies, bhisties, carpenters, etc. The materials required for the construction as bricks, cement, sand, lime, surkhi, timber, steel, etc. and the tools and plants required for the operation, are got issued from the store by indent or purchased directly chargeable to the work. The attendance of the labourers is kept in muster roll by the overseer or by his authorised agent as work-supervisor, mistry, maul etc. The attendance of labour is checked, and intialled by Assistant Engineer or Sub-divisional or Divisional Engineer frequently during their inspections.

Muster Roll (M.R.): The muster roll consists of two parts:

Part I: Nominal roll where daily attendance are recorded. In this part there are column and spaces for the names of the labourer, designation, father's name, dates of attendance, rates, total amount due for each, total amount due for whole, signature of the person taking attendance, signature of the officer making payment etc. and these column are duly filled up. Fines if inflicted on the labourer is recorded in Part I-Muster Roll should never be made in duplicate and entries should be made in such manner (with ink) that it may not be possible to interpolate or to alter them.

Part II: Details of quantity of work done by the labourer and the progress of work are recorded in this part. Details of measurement are taken and entered in the measurement book and an "Abstract of quantities" is prepared sub-headwise and this 'abstract of quantities' is recorded in part II of the Muster Roll giving reference of M.B. If the work is not susceptible to measurement a remark to this effect should be recorded in this part.

(b) Salvage and Scrap value

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Ans. Salvage value: It is the value at the end of the utility period without being dismantled. A machine after the completion of its usual span of life or when it become uneconomic, may be sold and one may purchase the same for some other purpose, the sale value of the machine is the salvage value.

Scrap value: It is the value of dismantled materials. For a building when the life is over at the end of its utility period the dismantled materials as steel, bricks, timber, etc. will fetch is a certain amount which is the scrap value of the building.

(c) Earnest Money

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Ans. Earnest money: While submitting a tender the contractor is to deposit a certain amount, about 2% of the estimated cost, with the department, as earnest money as guarantee of the tender. This amount is for a check so that the contractor may not refuse to accept the work or run away when his tender is accepted. In case the contractor refuses to take up the work his earnest money is forfeited. Earnest money of the tenderer whose tender has not been accepted is refundable.

(d) Tender and acceptance of tender.

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Ans. Tender: It is an offer in writing to execute some specified work or to supply some specified articles at certain rates, within a fixed time under certain conditions of contract and agreement, between the contractor and the department or owner or party. The construction of work is usually done by contract. Scaled tenders are invited and the work is usually entrusted to the lowest tender. While inviting tenders the bill of quantities, detailed specifications, conditions of contract and plans and drawings are supplied on payment of the requisite cost to the contractors who tender or quote their rates.

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ESTIMATING AND COSTING

December-2012

Paper Code: CE-405-F

Q. 1. (a) What are derived units? Give example.

Ans. Derived units: the expressions for the derived SI units are stated in the terms of the basic units, as the SI units for velocity is m/sec.

(b) What is prescribed form to fill details of measurements?

Ans.

Particulars	Detail of actual measurement				Contents of area
	No.	L	B	D	

(c) List the data required to make out an estimate for a work.

Ans. To make out an estimate for a work, the following data is necessary:

- Drawings (plans and section)
- Specifications
- Rates

(d) What is the labour required for earthwork per 28.30 cum.

Ans.

Mistri (Head Mason)	-	1½ No.
Mason	-	3 No.
Mazdoor (Beloar)	-	35 Nos.
Boy or woman coolie	-	35 Nos.
Bhisai (water-man)	-	8 Nos.

(e) Discuss the importance of rate analysis.

Ans. Importance of rate analysis: The details about all the operations involved in carrying out the work should be available, the quantities of materials required and their costs should be known and no. of different categories of labourers required and the capacity of doing work per labourer and their wages should be known.

(f) Mention the general specification for flooring of a first class building.

Ans. Flooring: Drawing room and dining room floors shall be of Terrazo. Bathroom and W.C. floors and dado shall be of mosaic-floors of bedrooms shall be coloured and polished 2.5 cm (1") cement concrete over 7.5 cm (3") lime concrete floors of others shall be 2.5 cm (1") cement concrete over 3" (7.5 cm) lime concrete polished.

(g) A property fetches a net annual income of ₹ 900.00 deducting all outgoing. Work out the capitalized value of the property if the rate of interest is 6% per annum.

Ans. For ₹ 6.00 Interest, capital = ₹ 900

To get ₹ 900/- interest, capital = $\frac{100}{6} \times 900 = \frac{90000}{6} = 15,000/-$ Ans.

(h) What do you mean by sinking fund?

Ans. Sinking Fund: The fund which is gradually accumulated by way of periodic annual deposit for the replacement of the building or structure at the end of its useful life is c/a sinking fund.

(i) What procedure is followed for cancellation of an entry in a measurement book?

Ans. Entry should be cancelled by diagonal lines and cancellation being initialled and attested and dated.

(j) When is rental method of valuation is applicable?

2 × 10 = 20

Ans. Method of Valuation: The following are the different methods of valuation:

(1) Rental method of valuation (2) Direct comparisons of the capital value (3) Valuation based on the profit (4) Valuation based on the cost (5) Development method of valuation (6) Depreciation method of valuation.

Rental method of valuation: In this method, the net income by way of rent is found out by deducting all outgoings from the gross rent. A suitable rate of interest as prevailing in the market is assumed and year's purchase is calculated. This net income multiplied by Y.P. gives the capitalized value or valuation of the property. This method is applicable only when the rent is known as probably rent is determined by enquiries.

SECTION-A

Q. 2. (a) What are different methods of building estimate? Explain briefly. 10

Ans. Various methods of estimation: For symmetrical foundation, which is the usual case, earthwork in excavation in foundation, foundation concrete, brickwork in foundation and plinth and brickwork in superstructure may be estimated by the following 2 methods:

- Separate or individual wall method.
- Centre line method

• In separate wall method, measure or find out the external length of walls running in the longitudinal direction generally the long walls out-to-out and the internal lengths of walls running in the transverse direction in-to-in i.e., of cross or short walls in-to-in and calculate quantities multiplying the length by breadth and height of the wall. The same rule applies to the excavation in the foundation, to concrete in foundation and to masonry.

• In centre line method, sum-total length of centre lines of walls, long and short, has to be found out find the total length of centre lines of walls, of same type, long and short having same type of foundations and footings and then find quantities by multiplying the total centre length, the respective breadth and the height. In this method, the length will remain the same for excavation in foundation, for concrete in foundation, for all footings and for superstructure. This method is quick but requires special attention and consideration at the junctions, meeting points of partition or cross walls etc.

(b) Discuss general items of work for building construction.

Ans. Items of Works: The main items of works are:

- Earthwork
- Concrete in foundation
- Masonry
- Soiling
- Damp proof course

– **Earthwork:** Earthwork is excavation and earthwork in filling are usually taken out separately under different items and quantities are calculated in cu.m.

– **Concrete in foundation:** The concrete is taken out in cu.m by length \times breadth \times thickness. The length and breadth of foundation concrete are usually the same as for excavation, only the depth or thickness differs.

– **Soiling:** When the soil is soft or bad, one layer of dry brick or stone soiling is applied below the foundation concrete. The soiling layer is computed in m^2 (length \times breadth) specifying the thickness.

– **Damp proof course:** D.P.C. usually of 2.5 cm (1") thick rich cement concrete 1:1½:3 or 2 cm (¾") thick rich cement mortar 1:2, mixed with standard water proofing material is provided at the plinth level to full width of plinth wall and the quantities are computed in m^2 (length \times breadth).

– **Masonry:** It is computed in m^3 (L \times B \times H). Foundation and plinth masonry is taken under one item, and masonry in superstructure is taken under a separate item.

Q. 3. (a) Write down the material requirement for different proportion of cement concrete for 10 cu.m.

Ans. Material required for different proportion of cement concrete—10 cu m.

Quantity of materials may be calculated by taking 15.2 as sum total and dividing by sum of the proportions.

Proportion	Ballas	Sand	Cement
1 : 1½ : 3	8.40 cu m	4.20 cu m	2.80 cu m
1 : 2 : 4	8.80 cu m	4.40 cu m	2.20 cu m
1 : 3 : 6	9.00 cu m	4.50 cu m	1.50 cu m
1 : 4 : 8	9.20 cu m	4.60 cu m	1.15 cu m
1 : 5 : 10	9.50 cu m	4.75 cu m	0.95 cu m
1 : 6 : 12	9.60 cu m	4.80 cu m	0.80 cu m

(b) The formation width of a hill road is 6 metre, the road is passing on hill side having the average cross-section as in Fig. 1. Calculate the quantity of earthwork for the meter length of the road. Estimate also the cost of earthwork at the rate of ₹ 275.00/cu.m.

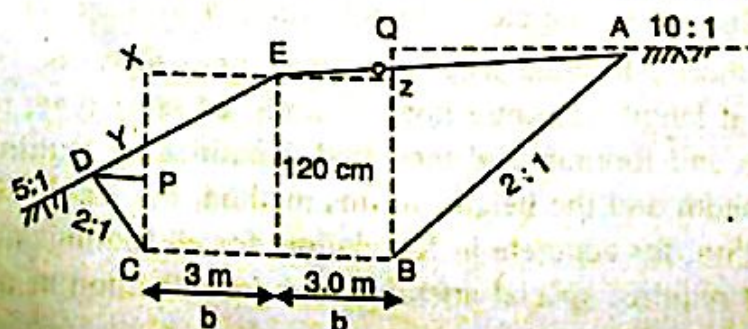


Fig. 1

Ans.

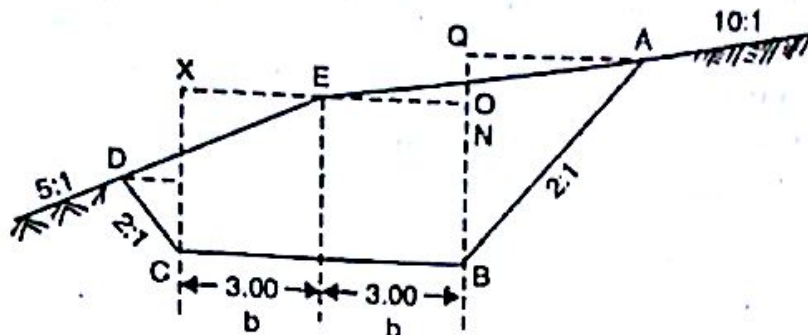


Fig. 2

$$r_1 = 10$$

$$r_2 = 5$$

Sectional Area = Area FBOE + Area FCYE + Δ ABO + Δ DCY

$$= \left(\frac{FE + BO}{2} \times b \right) + \left(\frac{FE + CY}{2} \times b \right) + \left(\frac{1}{2} BO \times AO \right) + \left(\frac{1}{2} CY \times DP \right)$$

$$FE = 1.20 \text{ m} \quad BO = d + \frac{b}{r_1} = 1.20 + \frac{3}{10} = 1.50 \text{ m}$$

$$CY = d - \frac{b}{r_2} = 1.20 - \frac{3}{5} = 0.60 \text{ m}$$

$$AQ = \frac{r_1 s}{r_1 - s} \left(d + \frac{b}{r_1} \right) = \frac{10 \times 2}{10 - 2} \left(1.20 + \frac{3}{10} \right) = 3.75 \text{ m}$$

$$DP = \frac{r_2 s}{r_2 + s} \left(d - \frac{b}{r_2} \right) = \frac{5 \times 2}{5 + 2} \left(1.20 - \frac{3}{5} \right) = 0.86 \text{ m}$$

Substituting in (i)

$$\begin{aligned} \text{Sec. area} &= \left(\frac{1.2 + 1.5}{2} \times 3.0 \right) + \left(\frac{1.2 + 0.6}{2} \times 3.0 \right) + \left(\frac{1}{2} \times 1.5 \times 3.75 \right) + \left(\frac{1}{2} \times 0.6 \times 0.86 \right) \\ &= \left(\frac{2.7}{2} \times 3.0 \right) + \left(\frac{1.8}{2} \times 3.0 \right) + \left(\frac{5.62}{2} \right) + \left(\frac{0.52}{2} \right) \\ &= 4.05 + 2.70 + 0.81 + 0.26 = 9.82 \text{ sq. m} \end{aligned}$$

$$\therefore \text{Quantity} = 9.82 \times 300 = 2946 \text{ cu m}$$

Abstract of cost

Earthwork in excavation

$$2946 \text{ cu m @ ₹ 275.00/cu m} = ₹ 8101.50$$

$$\text{Add 5% for Contingencies and work charged establishment} = ₹ 405.07$$

$$\text{Total} = ₹ 8506.57 \quad \text{Ans.}$$

SECTION-B

Q. 4. Write down the detailed specification of the following:

4 × 5 = 20

- (i) Brick work I-class
- (ii) White washing
- (iii) Earthwork in excavation in foundation
- (iv) Damp proof course 2.5 cm.

Ans. (i) Brick work I-class: Reinforced Concrete Cement (R.C.C): Steel—steel reinforcing bars shall be of mild steel or deformation steel of standard specifications and shall be free from corrosion, loose rust scales, oil, grease, paint etc. The steel bars shall be round and capable of being bent (doubled over) without fracture. Materials for concrete-cement, sand and coarse aggregate shall be same as for cement concrete. The stone aggregate shall usually be 20 mm to 6 mm (3/4" to 1/4") gauge unless otherwise specified.

(ii) White washing: The brand of the paint shall be specified and ready-made paint of the required colour should be used. If thinning is required, pure turpentine may be added to the required extent. The surface shall be made perfectly smooth by rubbing with sand paper of different grades, first with coarse one and successively with fine sand papers.

(iii) Earthwork in excavation in foundation: Earth work specifications—Foundation trenches shall be dug out to the exact width of foundation concrete and the sides shall be vertical. Excavated earth shall not be placed within 1m (3') of the edge of the trench.

The bottom of foundation trenches shall be perfectly levelled both longitudinally and transversely.

(iv) Damp proof course 2.5 cm: Materials—Damp proof course shall consist of cement coarse sand and stone aggregate of 1:1½:3 proportion with 2% of impermo or cem-seal, or Ac proof by weight of cement or other standard water proofing compound (1 kg per bag of cement). The damp proof course shall be applied at the plinth level in a horizontal layer of 2.5 cm thickness.

Q. 5. (a) Explain the following specifications:

- (i) General specification
- (ii) Detailed specification

Ans. Necessity of specifications: – Specifications specifies or describes the nature and the class of work, materials to be used in the work, workmanship etc. and is very important for the execution of the work. The cost of a work depends much on specifications. Specification should be clear and there should not be any ambiguity anywhere from the study of specifications, one can easily understand the nature of the work and what the work shall be. Drawings do not furnish the details of different items of work, the quantity of materials, proportion of mortar and workmanship which are described in specifications define completely the structure. Drawings and specifications form important parts of contract document.

– Specifications depends upon the nature of the work, the purpose for which the work is required, strength of the materials, availability of materials, quality of materials etc.

– Specification area of 2 types:

- (1) General or brief specification
- (2) Detailed specification

- General specifications gives the nature and class of the work and materials in general terms, to be used in the various parts of the work, from the foundation to the superstructure. It is a short description of different parts of works specifying materials, proportions, qualities, etc.
- The detailed specification is a detailed description and express the requirements in details. The D.S. of an item of work specifies the qualities and quantities of materials, the proportion of mortar, workmanship, the method of preparation and execution and the method of measurement.

(b) List out the points of difference between general specification of 1st, 2nd and 3rd Class Building.

Ans. General Specification of First Class Building:

Foundation and plinth: Shall be of 1-class brick work in lime mortar or 1:6 cement mortar over lime concrete or 1:4:8 cement concrete.

Damp proof course: D.P.C. shall be 2.5 cm (1") thick cement concrete 1:1½:3 mixed with one kg of impermo per bag of cement or other standard water proofing materials as specified and painted with two coats of bitumen.

Roofing: Roof shall be of R.C.C. slab with an insulation layer and lime concrete terracing above, supported over R.S. joists or R.C.C. beams as required. Height of rooms shall not be less than 3.7 m (12 feet).

Superstructure: Shall be of 1-class brickwork with lime mortar or 1:6 cement mortar. Lintels over doors and windows shall be of R.C.C.

Flooring: Drawing room and dinning room floors shall be of mosaic (terrazo). Bathroom and W.C. floors and dado shall be of mosaic (terrazo).

Finishing: Inside and outside walls shall be of 12 mm (½") cement lime plastered 1:1:6. Drawing, dinning and bedrooms-inside shall be distempered and other inside white washed 3 coats.

Miscellaneous: Rain water pipes of cast iron or of asbestos cement shall be provided and finished painted. Building shall be provided with 1st class sanitary and water fittings and electrical installations.

General Specifications of a Second Class Building:

Foundation and plinth: Foundation and plinth shall be of 1st class brickwork with lime mortar over lime concrete.

Damp proof course: D.P.C. shall be of 2 cm (¾") thick cement concrete 1:2 mixed with 1 kg of impermo per bag of cement or other standard water proofing materials.

Superstructure: Shall be of 2nd class brickwork in lime mortar. Lintels over doors and windows shall be of R.B.

Roofing: Roof shall be R.B. slab with 7.5 cm lime concrete terracing above (or flat terraced roof supported over wooden battens and beams, or jack arch roof). Varandah roof may be of A.C. sheet or Allahabad tiles.

Flooring: Floors shall be 2.5 cm (1") cement concrete over 7.5 cm (3") L.C. verandah floor shall be of brick tile or flag stone over lime concrete, finished cement painted.

Finishing: Inside and outside walls shall be of 12 mm lime mortar plastered 1:6. Ceiling shall be cement plastered 1:3. Inside shall be white washed 3 coats, colour washed two coats over one coat of white wash.

Miscellaneous: Rain water pipes shall be of cast iron finished painted. Electrification of sanitary and water fittings may be provided.

General Specifications of a Third Class Building:

Foundation and plinth: Foundation and plinth shall be of 2nd class brick work in lime mortar over lime concrete. Damp proof course shall be 2 cm thick cement mortar 1:2 mixed with standard water proofing compound.

Superstructure: Shall be of second class brickwork in mud mortar. Door and window opening shall be provided with arches of 2nd class brickwork in lime mortar or with wooden planks.

Roofing: Roof shall be of mud over tiles or bricks or planks over wooden beams or tile or G.I. sheet or A.C. sheet sloping roof.

Flooring: Floor shall be of brick-on-edge floor over well rammed earth.

Finishing: Inside and outside walls shall be plastered with lime mortar and white wash three coats.

Doors and Windows: Chauthat shall be of salwood, and shutters of chir mango or other country wood. Doors and windows shall be painted two coats with ordinary paint over one coat of priming.

SECTION-C

Q. 6. (a) What is the analysis of rate? Discuss its importance. What is the approximate quantity of work or out-turn for an average artisan per day? (any six)?

Ans. The determination of rate per unit of a particular item of work, from the cost quantities of materials, the cost of labourer and other miscellaneous petty expenses required for its completion is known as the analysis of rate. A reasonable profit, usually 10% for a contractor is also included in the analysis of rate. Rates of materials are usually taken as rates delivered at the site of work and include the first cost (cost at origin), cost of transport, railway freight if any, taxes, etc. If the materials are to be carried from a distant place, more than 8 kms (5 miles), then cost of transport is also added. The rates of materials and labour vary from place to place and therefore, the rates of different items of work also vary from place to place.

For the purpose of analysis, the details about all the operation involved in carrying out the work should be available, the quantities of materials required and their costs should be known and the number of different categories of labourers required and the capacity of doing work of labourer and their wages per day should be known. These can be known only from experience of practical works.

(b) Write down unit of measurement, unit rate of payment and mode of measurement for the following general items of work:

- (i) Earth filling in plinth
- (ii) Cement Concrete
- (iii) White Washing
- (iv) Supply of Cement
- (v) Damp proof course

Ans. (i) **Earth filling in plinth:** Earthwork in excavation and earthwork in filling are usually taken out separately under different items and quantities are calculated in cu m.

(ii) **Cement Concrete:** The concrete is taken out in cum by length \times breadth \times thickness. The length and breadth of foundation concrete are usually same as for excavation only the depth of thickness differs.

(iii) **White washing:** The quantities are computed in square metre and are usually same as for plastering. The inside is usually white washed or distempered and this item will be same as for inside plaster. The outside is colour-washed and the quantities of colour-washing will be same as for outside plaster. These items need not be calculated separately, but simply written as same as for inside plaster or outside plaster.

(iv) **Reinforced Concrete Cement (R.C.C):** Steel—steel reinforcing bars shall be of mild steel or deformation steel of standard specifications and shall be free from corrosion, loose rust scales, oil, grease, paint etc. The steel bars shall be round and capable of being bent (doubled over) without fracture. Materials for concrete-cement, sand and coarse aggregate shall be same as for cement concrete. The stone aggregate shall usually be 20 mm to 6 mm ($3/4"$ to $1/4"$) gauge unless otherwise specified.

(v) **Damp proof course:** D.P.C. usually of 2.5 cm ($1"$) thick rich cement concrete 1:1½:3 or 2 cm ($3/4"$) thick rich cement mortar 1:2 mixed with standard water proofing material, is provided at the plinth level to full width of plinth wall, the quantities are computed in sq. metre (length \times breadth).

Q. 7. Describe the procedure for the calculation of rate for the following: $2 \times 10 = 20$

(i) Cement concrete, 1 : 5 : 10 in foundation with brick ballast 40 mm thick gauge – unit 1 cu m.

Ans. Cement concrete 1 : 5 : 10 in foundation or floor with brick ballast 40 mm ($1\frac{1}{2}"$). Thick gauge unit 1 cu m. Take-10 cu m.

Particulars	Quantity	Rate ₹ P.	Cost ₹ P.
Materials:			
Brick Ballast 1st class 40 mm gauge	9.50 cu m	300.00 per cu m	2850.00
Sand (Local)	4.75 cu m	100.00 per cu m	475.00
Cement (28½ bags)	0.95 cu m	3970.00 per cu m	3771.50
		Total	7096.50
Labour			
Mistri (Head mason)	½ h no.	100.00 per day	50.00
Mason	1½ nos.	90.00 per day	135.00
Mazdoor (Beldar)	12 nos.	50.00 per day	600.00
Bay or woman coolie	18 nos.	40.00 per day	720.00
Bhishti (including curing)	4 nos.	50.00 per day	200.00

Sundries, T. and P. etc.	Lump sum	35.00 L.S.	35.00
		Total	1740.00
		Total of materials and labour	8836.50
Add 1½% water charges			132.55
Add 10% contractor's profit			883.65
	Grand Total		9852.70

Rate per cu m = ₹ 9852.70/10 = ₹ 985.30 per cu m.

(ii) R.C.C. brick work on slabs etc. 1 : 3 mortar – unit 1 cum.

Ans. Reinforced Brick work (R.B. work) in slabs, 1 : 3 mortar-units 1 cu m. Take-10 cu m.

Particulars	Quantity	Rate ₹ P.	Cost ₹ P.
Materials:			
Bricks I-class @ 450	4,500 nos;	150.00 % nos.	6750.00
Cement (36 bags)	1.20 cu m	3970.00 per cu m	4764.00
Sand (coarse)	3.60 cu m	500.00 per cu m	1800.00
Mild steel rods @ 0.8%			
= 0.08 cu m @ 78.5 q/cu m			
= 6.25 q	6.25 q	1450.00 per g	9062.50
		Total	22376.50
Labour			
Mistri (Head mason)	½ no.	100.00 per day	50.00
Mason	10 nos.	90.00 per day	900.00
Mazdoor (Beldar)	10 nos.	50.00 per day	500.00
Boy or woman coolie	10 nos.	40.00 per day	400.00
Bhishti (curing)	4 nos.	50.00 per day	200.00
Sundries, T. and P. etc.	Lump sum	35.00 L.S.	35.00
		Total	2085.00
Banding and cranking steel bars			
Blacksmith	6 nos.	80.00 per day	480.00
Mazdoor (Beldar)	6 nos.	50.00 per day	300.00
T. and P.	Lumpsum	15.00 L.S.	15.00
		Total	795.00
Centering and Shuttering			
Timber planets and ballies	Lump sum	450.00 L.S.	450.00
Carpenter (II class)	8 nos.	80.00 per day	640.00

Mazdoor (Beldar)	8 nos.	50.00 per day	400.00
Nails	Lump sum	60.00 L.S.	60.00
T. and P.	Lump sum	15.00 L.S.	15.00
Total			1565.00
Total of materials and labour			26821.50
Add 1½% water charges			402.32
Add 10% contractor's profit			2682.15
Grand Total			29905.97

Rate per cu m = $29905.97/10 = ₹ 2990.60$ per cu m.

SECTION-D

Q. 8. (a) What is the procedure of maintaining cash books.

10

Ans. Procedure of maintaining cash books:

1. All transaction w.r.t. receipts and payments entered in the cash book as soon as they occur, strictly in order of occurrence.
2. On payment side there are two money columns headed cash and bank or treasury to distinguish payments made by cheques from those out of cash in chest.
3. Cash balance in the chest is kept as low as possible consisted with immediate requirements.
4. The amount of cancelled cheque is shown by special write-back entry as a minus figure on the payment side in the bank of treasury column, and a counter reference to the second entry of the cheque is given in the cash book against the original entry.
5. When miscellaneous cash receipts are realised by the sub-ordinate officer and are either paid into the treasury are sent to the divisional or sub-divisional officer, they are incorporated in the cash book under the date on which the receipted challan of treasury or the amount in cash is received from the sub-ordinate officer.
6. To whom paid the name of person, or contractor or party, the name of work and such brief narration as to indicate the nature of transaction is entered, for each there on.
7. When an imprest is issued to the sub-ordinate officer the fact mentioning the amount of imprest is entered in payment side.
8. When money is advanced to sub-ordinate officer for payment to labourers, and work charged establishment.
9. When any money is received it is at once entered in the cash book and a receipt in form 3 is granted to the payer.
10. As far as possible no lines are left blank but if any space on a page of a cash book has been kept blank a diagonal line is drawn to cancel the blank space.
11. Sub-divisional cash book is usually closed on the 25th of every month except in the month of March when it is closed on the 31st of March.

12. The actual cash in cash chest is usually counted by S.D.O. or the Divisional officer at the closing of the account of the month.

13. Immediately after the cash book of S.D.O. has been closed, the cash balance report in form No. 5 is prepared and submitted alongwith copy of the cashbook of the divisional officer.

14. Copies of cash book supported with vouchers are sent by S.D.O. to the divisional officer twice a month usually on 10th and 25th.

(b) What is muster roll and its use? What are the rules followed to prepare muster roll? 10

Ans. Muster Roll: Work may be executed departmentally by employing daily labour, as masons, coolies, bhisties, carpenters etc. The materials required for the construction are bricks, cement, sand, lime, surkhi, timber, steel etc. and tools and plants required for the operations are got issued from the store by indent or purchased directly chargeable to the work. The attendance of the labourers is kept in Muster Roll by the overseer or by this authorised agent as work supervisor, mistry, mate etc. The attendance of labour is checked, and initialled by A.E. or S.D.O. frequently during their inspections.

Rule for preparation of Muster Roll: The muster Rolls are prepared and dealt in accordance with the following rules:

1. One or more muster rolls may be kept for each work, but M.R. should not be prepared in duplicate.

2. Labourers may be paid more than once in a month, but separate M.R. must be prepared for each period of payment.

3. The daily attendance and absence of labourers and fines imposed on them should be recorded in ink daily in the M.R.

4. After a M.R. has been passed payment should be made as quickly as possible, and each payment is initialled and dated by paying officer.

5. The amount of unpaid wages is deposited in the cash and the amount is kept as deposit.

Q. 9. Write short notes on:

$4 \times 5 = 20$

(i) Rental - return method

Ans. Rental method of valuation: In this method, the net income by way of rent is found out by deducting all outgoings from the gross rent. A suitable rate of interest as prevailing in the market is assumed and year's purchase is calculated. This net income multiplied by Y.P. gives the capitalized value or valuation of the property. This method is applicable only when the rent is known as probably rent is determined by enquiries.

(ii) Principles of valuation

Ans. Principles of valuation: Valuation of a building depends on the type of the building, its structure and durability, on the situation, size, shape, frontage, width of roadways, the quality of materials used in the construction and present day prices of materials. This also depends on the height of the building, height of plinth, thickness of wall, nature of floor, roof, doors, windows, etc. A building located on the market area will have higher value than a similar building in the residential area. Building in the area having sewer, water supply and electricity will have increased value. Building on freehold land will have higher value than building on

leasehold land. the value also depends upon on the demands for purchase which varies from time to time.

(iii) Acceptance of tender

Ans. Acceptance of tenders: The tenders can be accepted by different authorities according to their power prescribed in financial rule. The following are the powers of different authorities for sanctioned work

Chief engineer	full power
Supertending engineer	full power
Executive engineer	upto ₹ 5,00,000.00
District engineer or S.D.O.	upto ₹ 50,000 00
Assistant engineer	upto ₹ 20,000.00

(iv) Different types of payment

Ans. Different types of payments: The payment to the contractors for works or for supply of materials, road, metal, tools and plants etc. are made on the basis of measurements recorded in the Measurement Book (M.B.) when the work or supply is completed or sufficiently progressed the detailed measurements are taken usually by the overseer and recorded in M.B. and an abstract of quantities is prepared and the cost is calculated.

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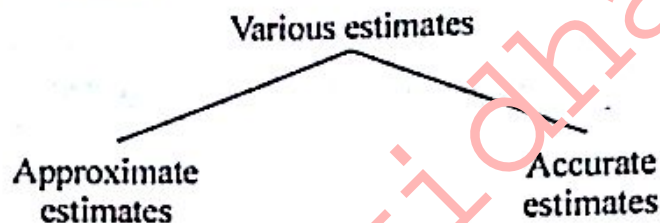
ESTIMATING AND COSTING

December-2011

Paper Code: CSE-201-E

Q. 1. (a) What is the principle of estimation? Classify the various kinds of estimates with examples. 10

Ans. Principle of Estimation: Before undertaking the construction of a project. It is necessary to know its probable cost which is worked out by estimating. An estimate is a computation or calculation of the quantities required and expenditure likely to be incurred in the construction of a work. The primary object of the estimate is to enable one to know beforehand, the cost of work. The estimate is the probable cost of a work and is determined theoretically by mathematical calculations based on the plans and drawings and current rates.



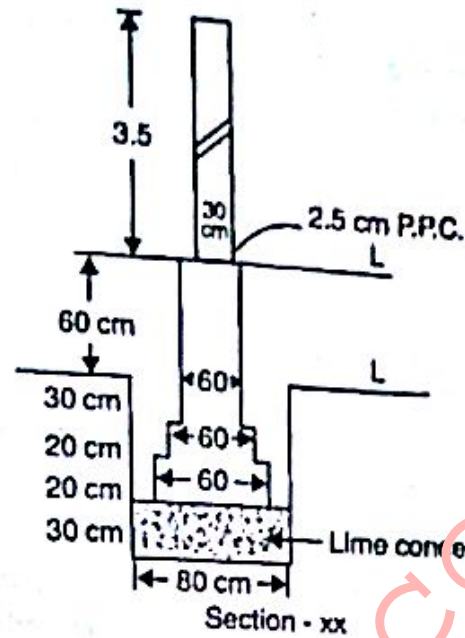
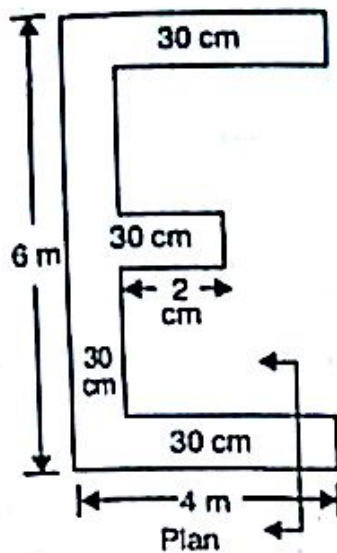
– Approximate estimate may be prepared by various methods but accurate estimate is prepared by detailed estimate method.

– Different kinds of estimate are:

- Preliminary estimate, e.g., in irrigation projects.
- Plinth area estimate, e.g., for storeyed buildings.
- Cube rate estimate, e.g., for buildings.
- Approximate quantity method estimate.
- Detailed estimate or item rate estimate.
- Revised estimate.
- Supplementary estimate.
- Annual repair and maintenance estimate.

(b) Prepare a detailed estimate of the building from the given plan and section and general specifications given as:

- (i) Foundation concrete shall be of lime concrete.
- (ii) Foundation and plinth shall be of 1st class brickwork in lime mortar.
- (iii) Damp proof course – 2.5 mm c/c 1 : 1½ : 3.
- (iv) Superstructure – 1st Class B.W in lime mortar.
- (v) Wall finishing – In side wall 12 mm cement plastered 1 : 6 and white washed 3 coats.



Ans.

S. No.	Particulars of Items	No.	Length	Breadth	Height	Quantity	Explanatory note
1.	Earthwork in excavation in foundation—						
	Long walls ...	2	6.20 m	.90 m	.90 m	10.04	Length = 5.30 + .90 = 6.20 m Breadth = 4.30 - .90 = 3.40 m
	Short walls ...	2	3.40 m	.90 m	.90 m	5.51	
					Total	15.55 cu m	
2.	Concrete in foundation—						
	Long walls ...	2	6.20 m	.90 m	.30 m	3.35	Length same as for excavation Quantity = 1/3 of excavation
	Short walls ...	2	3.40 m	.90 m	.30 m	1.83	
					Total	5.18 cu m	
3.	Brickwork in foundation and plinth—						
	Long walls—						
	1st footing ...	2	5.90 m	.60 m	.30 m	2.13	Length = 5.30 + .60 = 5.90 m Length = 5.30 + .50 = 5.80 m Length = 5.30 + .40 = 5.70 m
	2nd footing ...	2	5.80 m	.50 m	.30 m	1.74	
	Plinth walls ...	2	5.70 m	.40 m	.60 m	2.74	
	Short walls—						
	1st footing ...	2	3.70 m	.60 m	.30 m	1.33	Length = 4.30 - .60 = 3.70 m Length = 4.30 - .50 = 3.80 m Length = 4.30 - .40 = 3.90 m
	2nd footing ...	2	3.80 m	.50 m	.30 m	1.14	
	Plinth walls ...	2	3.90 m	.40 m	.60 m	1.87	
					Total	10.95 cu m	

4.	Brickwork in superstructure						Length = $5.30 + .30 = 5.60$ m Length = $4.30 - .30 = 4.00$ m
	Long walls ...	2	5.60 m	.30 m	3.50 m	11.76	
	Short walls ...	2	4.00 m	.30 m	3.50 m	8.40	
	Total					20.16 cu m	

Q. 2. (a) What are the various methods of estimation? Compare them with respect to their utility. 10

Ans. Various methods of estimation: For symmetrical foundation, which is the usual case, earthwork in excavation in foundation, foundation concrete, brickwork in foundation and plinth and brickwork in superstructure may be estimated by the following 2 methods:

- Separate or individual wall method.
- Centre line method.

• In separate wall method, measure or find out the external length of walls running in the longitudinal direction generally the long walls out-to-out and the internal lengths of walls running in the transverse direction in-to-in i.e., of cross or short walls in-to-in and calculate quantities multiplying the length by breadth and height of the wall. The same rule applies to the excavation in the foundation, to concrete in foundation and to masonry.

• In centre line method, sum-total length of centre lines of walls, long and short, has to be found out find the total length of centre lines of walls, of same type, long and short having same type of foundations and footings and then find quantities by multiplying the total centre length, the respective breadth and the height. In this method, the length will remain the same for excavation in foundation, for concrete in foundation, for all footings and for superstructure. This method is quick but requires special attention and consideration at the junctions meeting points of partition or cross walls etc.

(b) What do you understand by items of works. Explain the units required to measure them. (any five). 10

Ans. Items of Works: The main items of works are:

- Earthwork
- Concrete in foundation
- Masonry
- Soiling
- Damp proof course

- **Earthwork:** Earthwork is excavation and earthwork in filling are usually taken out separately under different items and quantities are calculated in cu.m.

- **Concrete in foundation:** The concrete is taken out in cu.m by length \times breadth \times thickness. The length and breadth of foundation concrete are usually the same as for excavation, only the depth or thickness differs.

- **Soiling:** When the soil is soft or bad, one layer of dry brick or stone soiling is applied below the foundation concrete. The soiling layer is computed in m^2 (length \times breadth) specifying the thickness.

- Damp proof course: D.P.C. usually of 2.5 cm (1") thick rich cement concrete 1:1½:3 or 2 cm (¾") thick rich cement mortar 1:2, mixed with standard water proofing material is provided at the plinth level to full width of plinth wall and the quantities are computed in m² (length × breadth).

- Masonry: It is computed in m³ (L × B × H). Foundation and plinth masonry is taken under one item, and masonry in superstructure is taken under a separate item.

Q. 3. (a) What is the necessity of specification? What is the difference between General specifications and detailed specifications?

Ans. Necessity of specifications: - Specifications specifies or describes the nature and the class of work, materials to be used in the work, workmanship etc. and is very important for the execution of the work. The cost of a work depends much on specifications. Specification should be clear and there should not be any ambiguity anywhere from the study of specifications, one can easily understand the nature of the work and what the work shall be. Drawings do not furnish the details of different items of work, the quantity of materials, proportion of mortar and workmanship which are described in specifications define completely the structure. Drawings and specifications form important parts of contract document.

- Specifications depends upon the nature of the work, the purpose for which the work is required, strength of the materials, availability of materials, quality of materials etc.

- Specification area of 2 types:

(1) General or brief specification

(2) Detailed specification

- General specifications gives the nature and class of the work and materials in general terms, to be used in the various parts of the work, from the foundation to the superstructure. It is a short description of different parts of work specifying materials, proportions, qualities, etc.

- The detailed specification is a detailed description and express the requirements in details. The D.S. of an item of work specifies the qualities and quantities of materials, the proportion of mortar, workmanship, the method of preparation and execution and the method of measurement.

(b) Give the specifications for:

(i) R.C.C.

Ans. R.C.C. specifications: Steel bars shall be of M.S. or deformed steel of standard specifications and shall be free from corrosion, loose rust scales, oil, grease, paint etc. cement concrete shall be of 1:2.4 proportion by volume for slabs, beams and lintels and 1:1½:3 proportion for columns.

(ii) Earth work

Ans. Earth work specifications: Foundation trenches shall be dug out to the exact width of foundation concrete and the sides shall be vertical. Excavated earth shall not be placed within 1m (3') of the edge of the trench.

The bottom of foundation trenches shall be perfectly levelled both longitudinally and transversely.

(iii) Painting

Ans. Painting specifications: The brand of the paint shall be specified and ready made paint of the required colour should be used. If thinning is required, pure turpentine may be added to the required extent. The surface shall be made perfectly smooth by rubbing with sand paper of different grades, first with coarse one and successively with fine sand papers.

(iv) Flooring

Ans. Flooring specifications: The cement concrete shall be of proportion 1:2:4 or 1:1½:3½ as specified. Cement shall be fresh portland cement of standard specifications. The floor shall be levelled and divided into panels of size not exceeding 1 m in its smaller dimensions and 2 m in large dimensions.

Q. 4. What are the specifications of buildings? Give the specifications for 1st class, 2nd class and 3rd class buildings. 20

Ans. General Specification of First Class Building:

Foundation and plinth: Shall be of I-class brick work in lime mortar or 1:6 cement mortar over lime concrete or 1:4:8 cement concrete.

Damp proof course: D.P.C. shall be 2.5 cm (1") thick cement concrete 1:1½:3 mixed with one kg of impermo per bag of cement or other standard water proofing materials as specified and painted with two coats of bitumen.

Roofing: Roof shall be of R.C.C. slab with an insulation layer and lime concrete terracing above, supported over R.S. joists or R.C.C. beams as required. Heights of rooms shall not be less than 3.7 m (12 feet).

Superstructure: Shall be of I-class brickwork with lime mortar or 1:6 cement mortar. Lintels over doors and windows shall be of R.C.C.

Flooring: Drawing room and dinning room floors shall be of mosaic (terrazo). Bathroom and W.C. floors and dado shall be of mosaic (terrazo).

Finishing: Inside and outside walls shall be of 12 mm (½") cement lime plastered 1:1:6. Drawing, dinning and bedrooms-inside shall be distempered and other inside white washed 3 coats.

Miscellaneous: Rain water pipes of cast iron or of asbestos cement shall be provided and finished painted. Building shall be provided with 1st class sanitary and water fittings and electrical installations.

General Specifications of a Second Class Building:

Foundation and plinth: Foundation and plinth shall be of 1st class brickwork with lime mortar over lime concrete.

Damp proof course: D.P.C. shall be of 2 cm (¾") thick cement concrete 1:2 mixed with 1 kg of impermo per bag of cement or other standard water proofing materials.

Superstructure: Shall be of 2nd class brickwork in lime mortar. Lintels over doors and windows shall be of R.B.

Roofing: Roof shall be R.B. slab with 7.5 cm lime concrete terracing above (or flat terraced roof supported over wooden battens and beams, or jack arch roof). Varandah roof may be of A.C. sheet or Allahabad tiles.

Flooring: Floors shall be 2.5 cm (1") cement concrete over 7.5 cm (3") L.C. verandah floor shall be of brick tile or flag stone over lime concrete, finished cement painted.

Finishing: Inside and outside walls shall be of 12 mm lime mortar plastered 1:6. Ceiling shall be cement plastered 1:3. Inside shall be white washed 3 coats, colour washed two coats over one coat of white wash.

Miscellaneous: Rain water pipes shall be of cast iron finished painted. Electrification and sanitary and water fittings may be provided.

General Specifications of a Third Class Building:

Foundation and plinth: Foundation and plinth shall be of 2nd class brick work in lime mortar over lime concrete. Damp proof course shall be 2 cm thick cement mortar 1:2 mixed with standard water proofing compound.

Superstructure: Shall be of second class brickwork in mud mortar. Door and window opening shall be provided with arches of 2nd class brickwork in lime mortar or with wooden planks.

Roofing: Roof shall be of mud over tiles or bricks or planks over wooden beams or of tile or G.I. sheet or A.C. sheet sloping roof.

Flooring: Floor shall be of brick-on-edge floor over well rammed earth.

Finishing: Inside and outside walls shall be plastered with lime mortar and white washed three coats.

Doors and Windows: Chaukhat shall be of salwood, and shutters of chir mango or other country wood. Doors and windows shall be painted two coats with ordinary paint over one coat of priming.

Q. 5. (a) Give the purpose, importance and requirements of rate analysis. What is the contribution of estimation in rate analysis?

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Ans. The determination of rate per unit of a particular item of work, from the cost of quantities of materials, the cost of labourer and other miscellaneous petty expenses require for its completion is known as the analysis of rate. A reasonable profit, usually 10% for the contractor is also included in the analysis of rate. Rates of materials are usually taken as the rates delivered at the site of work and include the first cost (cost at origin), cost of transport, railway freight if any, taxes, etc. If the materials are to be carried from a distant place, more than 8 kms (5 miles), then cost of transport is also added. The rates of materials and labour vary from place to place and therefore the rates of different items of work also vary from place to place.

For the purpose of analysis, the details about all the operation involved in carrying out the work should be available, the quantities of materials required and their costs should be known and the number of different categories of labourers required and the capacity of doing work per labourer and their wages per day should be known. These can be known only from experience of practical works.

(b) Calculate the rate for a 20 m length, 5 m height and 30 m nominal thickness (1½ brick thick) wall.

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Ans. Normally mortar joint will be less than 1 cm, taking 1 cm mortar joint, the actual thickness of wall be 29 cm.

∴ Actual volume = $20 \times 0.29 \times 5 = 29 \text{ m}^3$

No. of standard bricks of $20 \text{ cm} \times 10 \text{ cm} \times 10 \text{ cm}$ nominal size

$$= \frac{29}{0.20 \times 0.10 \times 0.10} = 14500 \text{ Nos.}$$

∴ No. of bricks per cu-m (nominal) = $\frac{14500}{30} = 484 \text{ Nos.}$

– Considering 5% breakages, wastages etc. = 500 Nos. per cu.m.

– For 10 cu.m of between 5000 bricks are required.

Q. 6. Write the procedure of rate analysis for:

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(i) Earthwork

(ii) Concrete works

(iii) Finishing (white washing, distempering)

(iv) Reinforced brick work

Ans. Earthwork:

- Calculate materials required like labour etc.
- Labour i/c mistri, mazdoor, boy or woman coolie, sundries (T&P). etc.
- Add 10% contractor's profit.
- Then calculate the rate per cubic metre.

Concrete Works:

- Calculate materials required (i/c stone ballast, sand (coarse), cement, etc.)
- Calculate labour required (head mason, mason, beldar, boy or woman coolie, bhisti (i/c curing), forms, sundries (T&P) etc.).
- Add 1½% water charges.
- Add 10% contractor's profit.
- Then calculate the rate per cubic metre.

Finishing (White Washing, Distempering):

- Calculate the materials required (white lime slaked, glue powder, blue (pigment colour), colouring matter (pigment)).
- Calculate the labour required (white washer, boy coolie, sundries (T&P)).
- Then calculate the rate per sq. m.

Reinforced Brick Work:

- Calculate materials required (Brick I-class, cement, sand (coarse), mild steel rods).
- Calculate labour required (Head mason, mason, mazdoor/beldar, boy or woman coolie, bhisti (i/c curing), sundries (T&P)).
- Calculate bending and cranking steel bars:
 - Blacksmith (IInd class), Mazdoor (Beldar) (T&P).
- Centering and shuttering (both erection and dismantling):
 - Timber planks and ballies

- Carpenter (IInd class)
- Mazdoor (Beldar)
- Nails
- T&P.

- Then add $1\frac{1}{2}\%$ water charges and 10% contractor's profit.
- Then calculate rate per m^3 .

Q. 7. (a) What do you understand by tender? What are the various features essential for a tender?

Ans. Tender: It is an offer in writing to execute some specified work or to supply some specified articles at certain rates, within a fixed time under certain conditions of contract and agreement, between the contractor and the department or owner or party. The construction of work is usually done by contract. Sealed tenders are invited and the work is usually entrusted to the lowest tender. While inviting tenders the bill of quantities detailed specifications, conditions of contract and plans and drawings are supplied on payment of the requisite cost to the contractors who tender or quote their rates.

(b) What is the purpose of maintaining muster roll? How is pay bill prepared using muster roll?

Ans. Muster Roll: Work may be executed departmentally by employing daily labour, as masons, coolies, bhisties, carpenters, etc. The materials required for the construction as bricks, cement, sand, lime, surkhi, timber, steel, etc. and the tools and plants required for the operation, are got issued from the store by indent or purchased directly chargeable to the work. The attendance of the labourers is kept in muster roll by the overseer or by his authorised agent as work-supervisor, mistry, mate etc. The attendance of labour is checked, and intialled by Assistant Engineer or Sub-divisional or Divisional Engineer frequently during their inspections.

Muster Roll (M.R): The muster roll consists of two parts:

Part I: Nominal roll where daily attendance are recorded. In this part there are column and spaces for the names of the labourer, designation, father's name, dates of attendance, rates, total amount due for each, total amount due for whole, signature of the person taking attendance, signature of the officer making payment etc. and these columns are duly filled up. Fines if inflicted on the labourer is recorded in Part I-Muster Roll should never be made in duplicate and entries should be made in such manner (with ink) that it may not be possible to interpolate or to alter them.

Part II: Details of quantity of work done by the labourer and the progress of work are recorded in this part. Details of measurement are taken and entered in the measurement book and an "Abstract of quantities" is prepared sub-headwise and this 'abstract of quantities' is recorded in part II of the Muster Roll giving reference of M.B. If the work is not susceptible to measurement a remark to this effect should be recorded in this part.

Q. 8. Write short notes on:

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(i) Earnest money

Ans. Earnest money: While submitting a tender the contractor is to deposit a certain amount, about 2% of the estimated cost, with the department, as earnest money as guarantee of the tender. This amount is for a check so that the contractor may not refuse to accept the work

or run away when his tender is accepted. In case the contractor refuses to take up the work his earnest money is forfeited. Earnest money of the tenderer whose tender has not been accepted is refundable.

(ii) First and final bill

Ans. The term indicates a single payment, made for a job or contract on its completion. In this case the payment finished by one payment after the completion at the work. This is usually applicable for small work.

(iii) Administrative sanction

Ans. Administrative sanction: For any work or project required by a department, an approval or sanction of the competent authority of the department, w.r.t. the cost and work is necessary at the first instance. The approval authorises the engineering department to take up the work. Administrative approval denotes the formal acceptance by the department concerned of the proposal and after the administrative approval is given the engineering department (P.W.D.) take up the work and prepares detailed designs, plans and estimates and then executes the work.

(iv) Cash Book

Ans. Cash Book: The transactions relating to the actual receipt and payment of cash are recorded in a register, made of P.W.A. form No. 1 known as Cash Book. The cash book is one of the most important record and posted and maintained correctly day-by-day in the divisional office and sub-divisional office.

The pages of cash books are machine numbered and each page is divided into receipt side (left hand) and payment side (right hand).

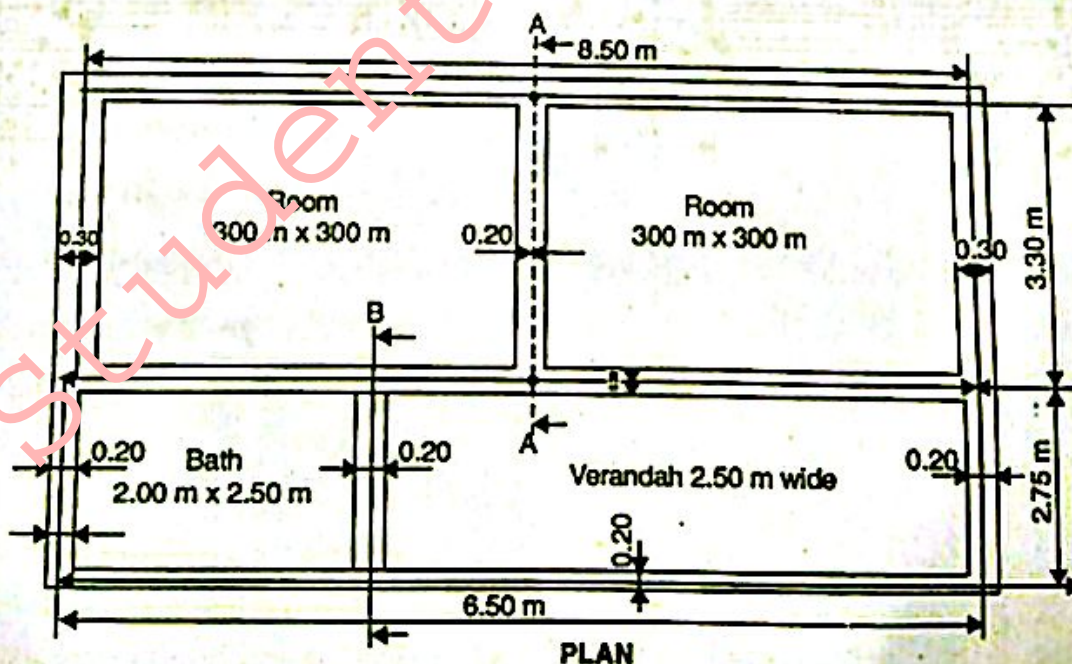
(v) Security Money

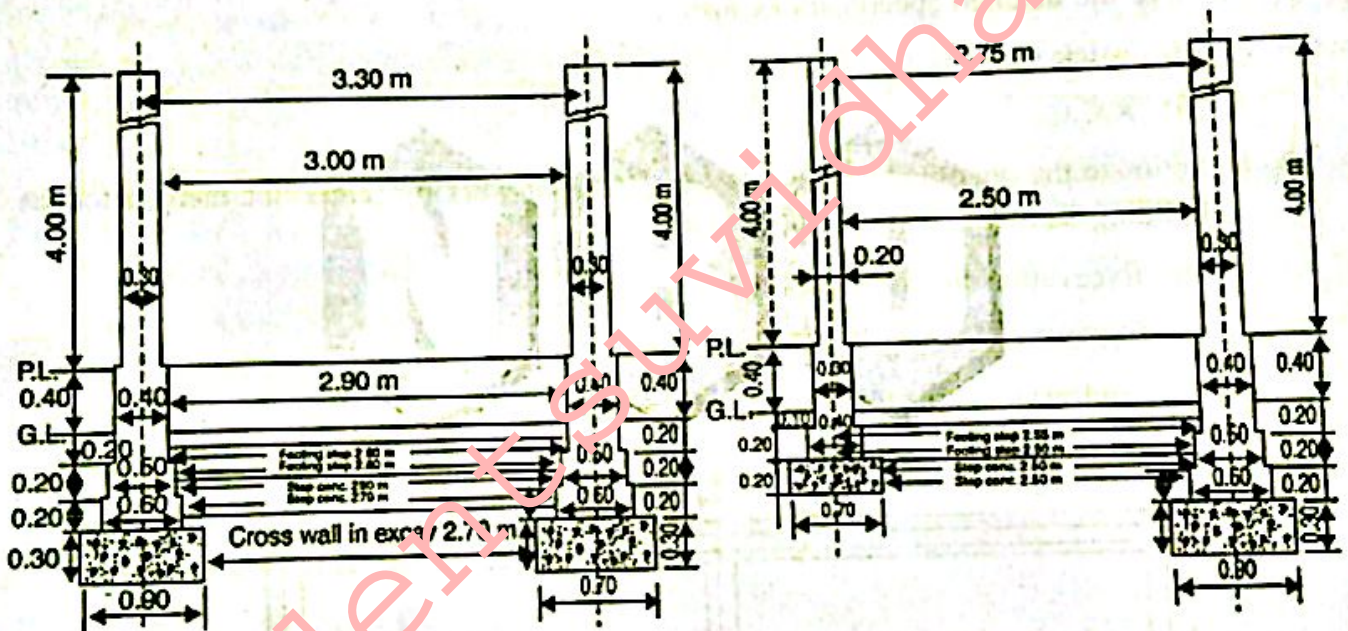
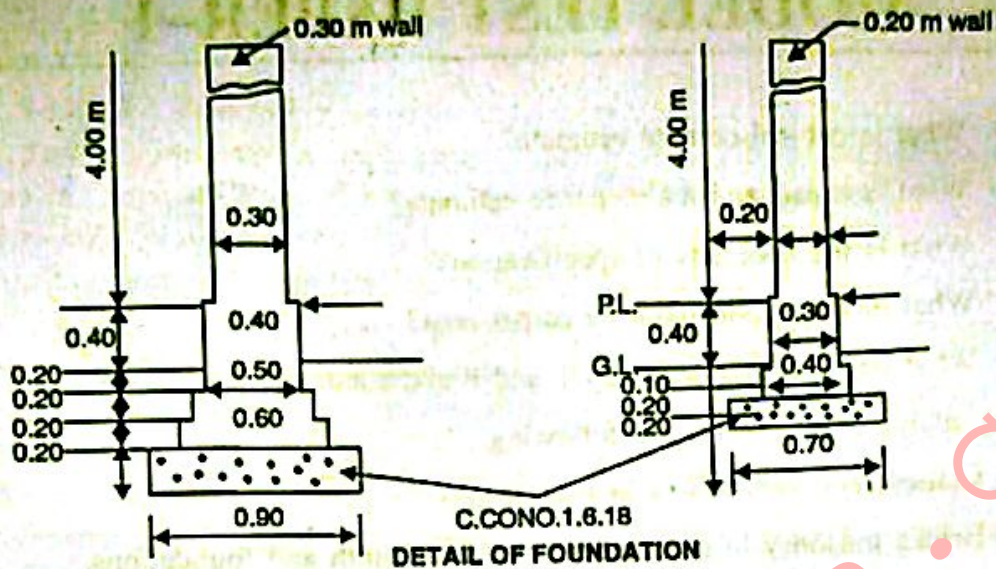
Ans. Security Money: On acceptance of the tender, the contractor has to deposit 10% of the tendered amount as security money with the department which is inclusive of the earnest money already deposited. This amount is kept as a check so that the contractor fulfills at the terms and conditions of the contract and carries out the work satisfactorily according to the specifications and maintain progress and completes the work in time. If the contractor fails to fulfill the terms of contract his whole or part of the security money is forfeited by the department.

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MODEL TEST PAPER-1

- Q. 1. (a) What is cubical content estimate?
(b) What is repair and maintenance estimate?
(c) What is the necessity of specifications?
(d) What do you understand by carpet area?
(e) What do you understand by T and P and sundries?
- Q. 2. Give analysis of rates for the following:
(a) Cement concrete 1:5:10 in foundations.
(b) Bricks masonry in cement mortar 1:4 in plinth and foundations.
- Q. 3. Give the detailed specifications for:
(a) Brick work
(b) R.C.C
- Q. 4. Estimate the quantities of the following items of work by centre-line-method for the building shown in figure below:
(a) Excavation for foundation
(b) Cement concrete 1:6:18 in foundation
(c) Mud masonry in foundations and plinth





MODEL TEST PAPER-2

- Q. 1. (a) What is measurement book?
(b) What is earnest money?
(c) What is security money?
(d) What is the purpose of valuation?
(e) What do you understand by year's purchase?
- Q. 2. (a) Enumerate the principles that should be observed at the time of evaluating a fairly and reasonable value of property.
(b) A property has been purchased by a person at a cost of ₹ 60,000/- excluding the cost of land. Determine the amount of sinking fund deposited at the rate of 5% compound interest. Assume the future life of the building as 20 years and scrap value of the building materials as 10% of the cost of purchase.
- Q. 3. (a) What are the rules for writing a muster roll? Explain.
(b) What do you understand by:
(i) First and final payment
(ii) Running or interim payment
(iii) Preparation of pay bill
(iv) Secured advance
(v) Advance payment
- Q. 4. Write short notes on the following:
(a) Tender document
(b) Procedure for dealing with ambiguities in rates in tenders.
(c) Acceptance of tenders

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